SURFACE ENVIRONMENT & MINING

SEAM

USDA FOREST SERVICE PROGRAM

WILDLIFE

USER GUIDE For Mining and Reclamation

U.S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE
GENERAL TECHNICAL REPORT INT-126
INTERMOUNTAIN FOREST AND RANGE
EXPERIMENT STATION
OGDEN, UTAH

SUMMARY

The biologist working on a forest where mining developments are occurring must be aware of the relationship between mining and the surface resources, wildlife in particular. This guide covers the major points of concern to the biologist involved in managing wildlife habitat when mineral activity is planned or is occurring. Topics include: the biologist's role in minerals-area management; the legal framework; land-management planning; the phases of mining; guidelines for assessing and evaluating the impacts of mining on wildlife; mitigation measures; and opportunities for wildlife management.

Information includes supporting graphic material, a list of additional sources of information, and a glossary.

ACKNOWLEDGMENTS

The contents of this guide are based on presentations and discussions during the USDA Forest Service sponsored Wildlife User Guide Workshop, held May 6-8, 1981, Ogden, Utah. Credit is due all attendees and presenters for their input. Those who attended are listed in appendix B.

A special note of thanks is extended to John Mumma, Don Duff, Coy Jemmett, Frank Gunnell, Stu Herkenhoff, Phil Janik, Jim McKibben, Paul Shields, Terry Solberg, Ron Escano, and Don Ward, USDA Forest Service, and Phil Dittenberner, U.S. Fish and Wildlife Service, members of the cadre which planned the workshop. The program coordinator of the User Guide Project was Edwin R. Browning, USDA Forest Service.

USDA Forest Service
General Technical Report INT-126
July 1982

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FOR
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Forest Service
U.S. Department of Agriculture
Ogden, Utah 84401

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Figure 1. Hardrock mining in alpine ecosystem.

Figure 2. Mining operation.

Figure 4. Oil and gas drilling.

Figure 5. Powerlines are one type of ancillary facility.

Figures 1-5. This guide discusses the relationships between mining activities and wildlife.

INTRODUCTION

The Forest Service biologist involved in mineral activities needs a working knowledge of mineral law and an understanding of the nature of the activities necessary to manage wildlife during mineral projects. Therefore, this guide is intended to describe the relationship between mineral activities and wildlife and to aid the biologist in the planning, evaluation, execution, monitoring, and reclamation work associated with mineral projects (fig. 1-5).

HOW TO USE THE GUIDE

The guide is structured so that it can be read in its entirety or used as a reference for addressing specific subjects. The first four chapters provide a background and develop a perspective, while chapters 5 through 7 contain information related to assessment of effects of mineral activities on wildlife, mitigation measures, and opportunities for managing wildlife that may be associated with mineral development.

The guide begins with a description of the role of the biologist in minerals activities (chapter 1). Chapter 2 contains a review of the laws that pertain to minerals and wildlife and is intended to provide a perspective for examining the legal mandates governing evaluation of minerals projects.

The significance of land-management planning to minerals-area management and wildlife goals and objectives is discussed in chapter 3. Information in this chapter should be useful when preparing land-management plans and when determining the applicability of approved land-management plans to proposed projects.

Chapter 4 provides a basic knowledge of mineral activities by types of mining. This chapter can also be used as a checklist of expected events that might be associated with a proposed mineral project.

Chapter 5 provides the link between the mineral activity and the expected changes in environmental factors. This chapter contains charts displaying estimates of relative magnitude and duration of the environmental changes from expected events; the estimates are intended to set the framework for assessing mineral projects or land-management planning.

Chapters 6 and 7 list potential changes that could result from mining activities, mitigation measures to consider, and opportunities for managing wildlife. Although chapters 6 and 7 can be used independently for reference, a thorough knowledge of the information in chapters 1 through 5 is recommended for a comprehensive understanding of the information. Provided in the appendices are a glossary of terms used in the publication and references to other wildlife/mineral information.

For the purpose of this guide, the term "wildlife" refers to both terrestrial and aquatic species, because mining can affect both land and water resources. Also, "mining" and "mineral activities" are used in a broad context and apply to locatable, leasable, and salable minerals.

OTHER USER GUIDES

This user guide is one of a series of guides that have been prepared as part of the USDA Forest Service Surface Environment and Mining (SEAM) program. The purpose of these publications is to help those involved in mineral activities more clearly understand their roles. The publications outline some of the major considerations that must be addressed to insure that mineral development is integrated with land-management plans; impacts are mitigated to an acceptable degree; and reclamation meets established performance standards. For those involved in minerals-area management, these guides are seen as a starting point to achieve the common goals of: (1) appropriate consideration

of mineral values in land-management planning; (2) protection of surface resources during mining activities; and (3) reclamation of surface-mined land to productive uses.

User guides on soils, vegetation, hydrology, engineering, and sociology and economics have been published. Each guide focuses on the respective discipline as it relates to managing surface resources affected by mineral activity. This publication is part of the series.

A Forest Service handbook for integrating minerals into the land-management planning process has been written ("Minerals Planning Handbook," FSH 2809.12). A handbook for land managers is also available that discusses the legal and administrative considerations surrounding mineral commodities commonly explored for and developed on National Forest Systems lands ("Land Manager's Handbook on Minerals Management," FSH 2809.11). A handbook on the minerals program (FSH 2809.13) has recently been written and is being printed.

BACKGROUND

Energy and mineral resources are the basic raw materials of United States industry and are highly important to the country's economy and national security. While imports can satisfy a part of the Nation's mineral demands, they tend to make the United States vulnerable to the economic and political decisions of foreign countries. Thus, the conservation and wise use of the mineral deposits within the United States are vital to this country's well-being.

A substantial portion of the domestic mineral supply presently comes from lands managed by the Federal Government. Federal lands are known to contain a majority of the metallic minerals, as well as major resources of coal, oil shale, tar sands, geothermal steam, uranium, and oil and gas.

The Forest Service, as one of the agencies responsible for Federal land management, has an opportunity and challenge to ease U.S. dependency on foreign mineral supplies by facilitating mineral and energy development within the National Forest System (NFS) in concert with other resources values. Considerable untapped mineral and energy resources underlie the 188 million acres of NFS lands. Approximately 6.5 million acres are underlain with coal. About 45 million acres hold potential for oil and gas production, while 300,000 acres have oil shale potential. Significant deposits of other mineral resources, such as cobalt, platinum, group metals, copper, and molybdenum are also found on NFS land.

In many instances, these resources are of low grade, or are in remote areas where development was previously impeded by forbidding terrain and climatic conditions. Today, higher prices, growing demands, and more sophisticated extraction and transportation techniques make development of mineral resources in these areas more attractive than ever. Also, more sophisticated exploration and prospecting techniques dictate that land areas once thought to be void of mineral resources will be explored again for deeper-lying resources. Consequently, industry has increased its prospecting, exploration, and development efforts on previously unexplored NFS lands.

These same Federal lands, however, also contain valuable nonmineral resources, including wildlife, timber, forage, water, scenic landforms, and wilderness. Public holdings of such nonmineral resources are currently among the most significant in the world.

While it is clearly in the national interest to provide for the exploration and production of mineral resources on Federal land, it is also necessary to provide for a sustained high-level output of the various renewable resources. Thus, the demand for mineral development must be balanced with the demand for renewable resources, and the land-management agency's responsibility to manage the environment associated with mineral-related operations.

The Forest Service's primary function in the Federal administration system is to manage renewable surface resources on National Forest System lands. Responsibilities regarding nonrenewable underground resources take shape from that primary surface-management charter. Basically, the Forest Service provides for exploration and extraction of mineral resources, while managing surface resources as provided by law. Even though the Forest Service has no direct responsibility for developing minerals, it has various surface-management authorities that influence the process considerably.

WILDLIFE AND MINERAL ACTIVITY

Because mining projects can affect land uses for long periods of time, individuals responsible for managing wildlife in mineralized areas need to understand the nature and extent of mineral activities that are likely to occur and how that activity could influence wildlife. Generally speaking, working with mineral activities on National Forest System lands is significantly different from working with renewable resources because:

- The Forest Service often does not know in advance where deposits of economically recoverable minerals lie. The technology for locating new mineral deposits is continually being developed and methods for extracting and processing low-grade minerals are improving, making possible the extraction of previously discovered minerals. Improved technology is resulting in mineral development in areas where it was not previously expected.
- In some cases, individuals and industry, not the Forest Service, have the legal right to choose the time and place to explore for some types of mineral resources; in other cases, law gives the public land manager some influence over the time and location of mineral activities.
- Forest Service authorities related to mineral activities are vastly different from its authorities for the management of surface resources. The authorities vary by class of mineral and by the status of the land and mineral estate.
- The Forest Service must respond to proposed project and operating plans within a given time period. This means that the biologist often has to respond with available information because there is not time for new studies or research.

Chapter 1

THE ROLE OF THE BIOLOGIST IN MINERALS-AREA MANAGEMENT

Forest Service biologists are involved with mineral activities on two levels: the broad, general level, which includes legal considerations and program tasks, and the site-specific level, which involves actual mining projects. This chapter presents an overview of the biologist's role in minerals-area management on both levels. Even though individual biologists may not participate at both the program and project levels, an understanding of both will help them work more effectively as members of the Forest Service team that advises on minerals-area management.

PROGRAM CONSIDERATIONS

The work of the Forest Service is organized into a number of resource and support "programs." A "program" is an administrative framework in which policy and decision-making, budgeting, on-the-ground activities, and reporting functions are accomplished. Wildlife and minerals are two of the Forest Service resource programs. Others are, for example, recreation and timber.

Wildlife goals and objectives are established through the interdisciplinary land-management planning process (fig. 6). In this process, all resources are considered, and a comprehensive surface-resource use policy is established by the land manager for an area. These goals and objectives provide guidance for integrating all activities on a given land area. The biologist's role and responsibilities in land-management planning are summarized in chapter 3 of this guide.

Other wildlife management activities also take place at the program level. For instance, an assessment of the workforce needed to respond to mineral activities is made. Part of this task is a determination of the number of people and the hours required to make sure that wildlife resources are adequately considered when making environmental assessments and monitoring mineral activities. Because wildlife management requires a knowledge of ecosystems and habitats, some gathering and analyzing of baseline data may take place at the program level.

The development of the program requires coordination with other resource specialists as well as affected Federal and State agencies. Administrative responsibilities among these groups may overlap, so consultation and coordination are often necessary before any firm decisions can be reached on wildlife management practices. This coordination should take place early in the planning process and affected agencies should be kept fully informed. The involved agencies often include the State wildlife agency, the U.S. Fish and Wildlife Service, and the Bureau of Land Management. The biologist can examine the scoping document to identify the needs for coordination.

Another important element of program work is establishing the wildlife budget. The ability to accomplish objectives is directly related to the dollars allocated to the wildlife program. Although budgeting involves numerous steps,

Figure 6. Interdisciplinary teams allow the biologist to participate with other specialists in planning and decision-making.

the following discussion focuses on wildlife budget considerations related to mineral activities.

To develop a wildlife budget that takes mineral activities into account, the biologist relies on the minerals program staff to forecast mineral activities that are likely to occur in the future. These forecasts must identify mineral activities likely to occur over a period of years, because budgets are developed 2-3 years or more prior to the fiscal year in which they are needed. The biologist's job is to use the forecasts to determine the amount of staffing needed to provide the wildlife support to the minerals program. Staffing and funding proposals are useful to the line officer in determining the overall budget.

When mineral activities are expected, the biologist needs to take the following action:

1. Obtain the mineral activity forecasts from the minerals staff. These should identify the operational phase of each expected project by year.
2. Identify the type of wildlife support work needed and plan an adequate budget.
3. Identify information needed from other resource specialists, such as hydrologists or soils scientists.
4. Consider what other circumstances, such as

Figure 7. Fisheries biologists monitor sediment and water quality to determine the effect of mining on fish populations.

hiring outside consultants, may arise that might require additional funding.

5. Consult with State and other Federal agencies (for example, the U.S. Fish and Wildlife Service) to determine if they will be involved, so that each agency can budget according to its own needs.

6. Negotiate with the minerals staff if the support area has not been included or adequately funded.

The budget system provides for including the financing needed for the wildlife support work to be planned and programmed as part of the minerals project. This insures that money will be available to finance the wildlife work when needed.

PROJECT CONSIDERATIONS

Mineral projects can take many forms, ranging from oil and gas exploration to drilling, and from determining the size and shape of an ore body to extracting the ore and reclaiming the site. When the biologist is asked to participate in the analysis and evaluation of a specific mineral project (or mining-related operation), certain procedures apply. First, the project is examined in light of the environmental, mineral, and wildlife laws that may apply to the situation. Then the proposed project is reviewed in light of the wildlife goals established during land-management planning.

This broad evaluation provides the framework for examining the project on a more detailed level. The proposed project is reviewed to determine: (1) the expected effects on wildlife; (2) how the expected effects will influence both wildlife and its habitat; (3) the extent to which the operator proposes to protect the wildlife resource during mining operations; and (4) other wildlife management practices the biologist believes are necessary.

The concept of reasonableness plays an important role in decision-making processes related to mineral proposals. What is reasonable is determined by considering all alternatives and then choosing the one that best answers the concerns of all parties.

For example, if a company proposes to begin work in 1 year's time, it is not practical for the company to gather information that would take 2-3 years to compile. Many companies are cooperative in regard to gathering baseline data prior to the start of an operation as well as throughout the life of the project. The biologist can help in maintaining this spirit of cooperation through his work with involved agencies and mining companies and by being responsive to time constraints.

Following approval of industry's operating plan, the biologist remains involved during the various phases of mineral activity. For example, the biologist, along with other designated resource specialists, will monitor the project to see if any adjustments are necessary (fig. 7). When considering adjustments and evaluating alternatives, the biologist identifies both onsite and offsite mitigation measures. This provides an opportunity to be innovative in stimulating new concepts in terms of treatments that are available through advancing technology.

Another aspect of the biologist's role is to identify needed research projects that often are identified during project evaluation. Research proposals are developed and submitted through appropriate Forest Service channels.

Note: a brief summary outline of the phases of mineral exploration and development activities is presented in table 1. A more in-depth discussion of these phases is found in chapter 4. The biologist's role within these activities is shown at the bottom of the table; it is also summarized in table 2, along with the roles of other Forest Service specialists.

Table 1.—*Phases of mineral exploration and development activities*[1]

Prospecting	Exploration	Feasibility studies/operating plan
A. Administrative Action No administrative action required; however, some evidence of mineralization or a hunch	**A. Administrative Action** Permit/Lease Notice of intent from miner (for certain commodities, may also serve as operating plan if there is minimal surface disturbance) Exploration license EA may be necessary See Land Manager's Handbook on Minerals Management for variation within commodities	**A. Administrative Action** Submission of necessary permits (EA, EIS, etc.) and operating plan—see Land Manager's Handbook on Minerals Management for variation within commodities
B. Activities Literature search Geological inference Evaluation of existing data Research on rights to land/minerals	**B. Activities** More intensive literature search Access road construction Onsite testing and evaluation of data—geological, geochemical, geophysical, drilling, sampling, shaft sinking Seismic activity Acquiring land/mineral rights Rehabilitation of exploration impacts Environmental and socioeconomic studies	**B. Activities** Feasibility studies Grade and size of deposit Cost of mining and rehabilitation Market Fiscal Technical studies—mine design Environmental and socioeconomic studies (if not done during exploration) Decision to proceed with development Preparation of operating plan including rehabilitation program and end use Ordering of equipment
C. Environmental Impacts Minimal, if any	**C. Environmental Impacts** Roads Drill holes Drill pads Dozer holes Exploration camps	**C. Environmental Impacts** Generally none at this stage
D. Tasks for the Biologist Complete wildlife action plan for mineral deposit areas Plan for: coordination with other State/Federal wildlife agenices' budget needs, collection of necessary baseline data, monitoring requirements, analysis of fish and wildlife values, and priorities	**D. Tasks for the Biologist** Review plans that affect the wildlife resource, determine need for more specific project level information, assist in study design and data collection Incorporate other State and Federal wildlife agency input, consider need for cooperative agreements or memorandums of understanding Review plans and recommend procedures to protect wildlife and to reclaim habitat affected by exploration	**D. Tasks for the Biologist** Review adequacy of operating plan for: wildlife considerations (harassment, human interference, habitat disturbance and loss, pollution, direct mortality, opportunities) Provide expertise in environmental analysis process Consider both onsite and offsite effects Assist in identifying State-Federal responsibilities for monitoring and evaluation Develop management options

[1]The various phases have considerable overlap. The material provided for each phase is illustrative, not complete, and considerable variation is found by mineral commodity. The existence of a forest plan is assumed. Tasks (D) are primarily input from a land-management agency's biologist. For purposes of discussion, the terms reclamation and rehabilitation are used interchangeably, and mining includes oil and gas activities.

Development[2]	Production/reclamation	Postmining
A. Administrative Action Approval of necessary operating plan	**A. Administrative Action** No administrative action required. Production overlaps with development and reclamation overlaps with production; reclamation of previously mined areas occurs concurrently with new production as stipulated in operating plan Any changes in operating plan	**A. Administrative Action** Release of reclamation bond
B. Activities Securing of financing More extensive testing and definition of the mineral Construction of transportation routes and utilities Construction of mine and processing plant (facilities, water supply, etc.) Construction of waste deposits Continued evaluation of data Change mining plan if necessary	**B. Activities** Extraction of mineral Processing of mineral Depositing wastes Operation of transportation systems Rehabilitation Monitoring for any changes in biological and physical environment Amend mining and rehabilitation plan if necessary	**B. Activities** Surface owner manages land after bond release Monitoring for any changes in biological and physical environment Management and maintenance for end-use objective
C. Environmental Impacts Mine Processing plant Waste dumps Transportation and access routes Utilities Increased population resulting from construction	**C. Environmental Impacts** Impacts directly related to operational aspects of production impacts are strongly affected by commodity and type of operation	**C. Environmental Impacts** Directly related to management and maintenance activities
D. Tasks for the Biologist Monitor wildlife impacts and activities for conformance to operating plan Advise on plan revisions when necessary, inform and involve mining companies on current studies and monitoring	**D. Tasks for the Biologist** Monitor wildlife impacts and activities for conformance to operating plan Advise on plan revisions when necessary, inform and involve mining companies on current studies and monitoring Provide ad hoc technical assistance	**D. Tasks for the Biologist** Monitor any continued impacts on wildlife Manage habitat for end-use objective

[2]Development is herein defined as the phase which begins after the right to mine has been established.

Table 2.—*Roles of Forest Service specialists in mineral activities*

	Prospecting	Exploration	Feasibility studies/operating plan
Biologist	Complete wildlife action plan for mineral deposit areas Plan for: coordination with other State/Federal wildlife agencies' budget needs, collection of necessary baseline data, monitoring requirements, analysis of fish and wildlife values, and priorities	Review plans that affect the wildlife resource, determine need for more specific project level information, assist in study design and data collection Incorporate other State and Federal wildlife agency input, consider need for cooperative agreements or memorandums of understanding Review plans and recommend procedures to protect wildlife and to reclaim habitat affected by exploration	Review adequacy of operating plan for wildlife considerations (harassment, human interference, habitat disturbance and loss, pollution, direct mortality, opportunities) Provide expertise in environmental analysis process Consider both onsite and offsite effects Assist in identifying State-Federal responsibilities for monitoring and evaluation Develop management options
Vegetation specialist	None at this point	Review of plans to reclaim land impacted by exploration Review and assist in vegetation aspects of environmental studies	Review adequacy of operating plan for: Reclamation program— species selection plant materials site preparation planting methods cultural treatments Monitoring/retreatment program for vegetation Vegetation aspects of end use
Soils scientist	None at this point	Review of plans to reclaim land impacted by exploration Review and assist in soils aspects of environmental studies Review soils inventory progress in the mineralized areas; if needed recommend timely completion or upgrading	Review adequacy of operating plan for: Reclamation program— soils surveys storage area selection materials handling plans spoils analysis plan spoils treatments spoils surfacing and erosion control Monitoring/retreatment program for soils Soils aspects of end use
Hydrologist	Establish baseline water-quality monitoring as needed according to plan	Review of plans to reclaim land impacted by exploration Review and assist in hydrologic aspects of environmental studies	Review adequacy of operating plan for: Hydrologic considerations— surface water subsurface water snow management roads impoundments mine drainage Hydrologic aspects of end use
Engineer	None at this point	Review of plans to reclaim land impacted by exploration Review and assist in engineering aspects of environmental studies	Review adequacy of operating plan for: Engineering considerations— air pollution transportation facilities surface-mine facilities mine-waste disposal embankments tailings dams and impoundments subsidence Engineering aspects of end use
Economist	Monitor factors which affect supply and demand for minerals Make forecasts of supply and demand Predict probability	Analyze costs and benefits of alternative exploration methods Participate with the sociologist in identification of existing and emerging issues	Provide expertise in environmental analysis process: issue identification decision criteria cost/benefit analysis of alternatives tradeoff and opportunity-cost evaluations Analyze effects of development on: demand for surface resources human behavioral patterns community economics
Sociologist	Identify the basic social/cultural descriptors of the affected communities Note current trends	Assist in structuring public involvement plan for appropriate: issue identification issue analysis mitigation action Identify critical trigger points from a social perspective	Provide expertise in environmental analysis process: decision criteria issue identification Analyze effects of development on the cultural and political community Consider effects of alternative plans on social well-being
Minerals program staff	Update mineral inventory/mineral activity forecasts as information becomes available May be assigned tasks of (1) resolving conflicts, (2) coordinating required Forest Service staff work, or (3) liaison with other Government agency activities during this phase Review prospecting operating plan/permit application, if required and prepare EA	Update LMP data base with new mineral information as it becomes available Review exploratory operating plan and help prepare EA, if required Consult with land manager on regulatory requirements and setting reclamation bond Serve as liaison between industry and Forest Service Serve as contact point with other Government agencies Judge reasonableness of mining activity; possible participation in any contest actions or resulting litigation, appeals, or congressionals	May serve as ID team leader in reviewing adequacy of operating plan: Coordinate activities of ID team/other Government agencies Prepare EA or EIS Interpret regulations Assist in public involvement activities Negotiate among interested parties Monitor conformance with approved operating plan

Development	Production/reclamation	Postmining
Monitor wildlife impacts and activities for conformance to operating plan Advise on plan revisions when necessary, inform and involve mining companies on current studies and monitoring	Monitor wildlife impacts and activities for conformance to operating plan Advise on plan revisions when necessary, inform and involve mining companies on current studies and monitoring Provide ad hoc technical assistance	Monitor any continued impacts on wildlife Manage habitat for end-use objectives
Monitor vegetation impacts and activities for conformance to operating plan Advise on plan revisions when necessary	Monitor vegetation impacts and activities for conformance to operating plan Advise on plan revisions when necessary Advise from a vegetation standpoint on release of reclamation bond	Monitor any continued impacts on vegetation Manage vegetation for end-use objectives
Monitor impacts on soils Monitor soils-related activities for conformance to operating plan Advise on plan revisions when necessary	Monitor soils impacts and activities for conformance to operating plan Advise on plan revisions when necessary Advise from a soils standpoint on release of reclamation bond	Monitor any continued impacts on soils Manage soils for end-use objectives
Monitor impacts on hydrology	Monitor impacts on hydrology and hydrologic aspects of rehabilitation program Have hydrologic input into release of reclamation bond	Monitor any continued impacts on hydrology Manage hydrology for end-use objectives
Monitor engineering-related activities for conformance to operating plan Advise on plan revisions when necessary	Advise from an engineering standpoint on release of reclamation bond	Monitor any continued impacts from engineered structures Manage structures for end-use objectives
Record costs Monitor economic changes	Record costs Monitor economic changes	Monitor to determine accuracy of predictions for future use
Monitor Record changes Identify areas of individual or group stress relating to mineral activity and make recommendations to mitigate effects	Monitor Record changes	Monitor and record critical changes to establish new baseline situation
Maintain liaison with appropriate industry/Government officials Respond to operating plan amendments Monitor for compliance with operating plan	Monitor conformance with approved plan: Liaison with appropriate Government agencies Monitor compliance with operating plan Negotiate among interested parties Monitor conformance with approved reclamation plan	Maintain liaison Inspect site regarding bond release

Chapter 2

LEGAL FOUNDATIONS

Working in minerals-area management requires a basic understanding of the Federal and State laws and regulations that govern mineral activities and the wildlife resource. Several broad categories of laws and regulations apply to mining and wildlife on National Forest System lands: (1) general laws; (2) mineral laws and the concept of split mineral and surface estates; and (3) wildlife laws.

The discussion of laws and regulations provided in this chapter is an overview of some of the major regulations that apply to mineral activity and wildlife management on National Forest System lands. The Forest Service has different authorities related to mineral resources and mining activities than it has for renewable surface resources. Mineral law governs the nature and extent of Forest Service authority relative to mineral operations. Authorities vary depending on the class of mineral (locatable, leasable, and salable), the status of the land (public domain or acquired), and the status of the mineral estate. Depending on the circumstances, Forest Service authority can range from total discretion, recommendation, consent, or the determination of mitigation requirements for the protection of surface resources.

Other agencies have significant authorities relative to minerals management on National Forest System lands. Some of the jurisdictions are spelled out in mining laws and regulations, while others have developed out of memorandums of understanding negotiated between different agencies.

This combination of laws, regulations, legal concepts, and memorandums of understanding sometimes creates complex situations. Where potential conflicts between mineral and wildlife laws exist, the biologist should consult with mineral law experts to clarify particular situations. The discussion of laws and regulations provided in this chapter is an overview of some of the major requirements that apply to mineral activity and wildlife management on National Forest System lands.

GENERAL LAWS

A brief summary of some of the major enabling legislation and environmental laws follows:

- **The Organic Administration Act of 1897.**[1] Although this act is not primarily concerned with mineral developments on National Forests, it provides for the continued right to conduct mining activities if the activities comply with the rules and regulations covering such National Forests. It also states that miners and prospectors have the right of ingress and egress into National Forests for all proper and lawful purposes, including that of prospecting, locating, and developing the mineral resources on the forests.
- **Multiple-Use Sustained Yield Act of 1960.**[2] This act authorizes and directs the Secretary of Agriculture to "develop and administer the renewable surface resources of the National Forests for multiple use and sustained yield of the several products and services obtained therefrom....Nothing herein shall be construed so as to affect the use or administration of the mineral resources of National Forest lands or to affect the use or administration of Federal lands not within National Forests."
- **The Wilderness Act of 1964.**[3] This act provides that from September 3, 1964 until mid-

[1] Act of June 4, 1897. (30 Stat. 34, as amended; 16 U.S.C. 473-478, 479-482, 551).

[2] Act of June 12, 1960. (74 Stat. 215, as amended; 16 U.S.C. 528-531).

[3] Act of September 3, 1964. (78 Stat. 890; 16 U.S.C. 1131-1136).

night December 31, 1983, lands classified as wilderness shall remain open to the action of the United States mining laws and all laws pertaining to mineral leasing. However, effective January 1, 1984, the wilderness areas are withdrawn from all forms of appropriation under the mining and mineral leasing laws. Patents (legal titles) issued for mining claims prior to 1984 will convey only mineral rights; surface rights will be reserved to the United States.

- **The National Environmental Policy Act of 1969 (NEPA).**[4] This act requires all Federal agencies to use a systematic, interdisciplinary approach to insure the integrated use of natural and social sciences in planning and decision-making. It also directs that a detailed environmental analysis of proposed Federal actions be completed to determine the effects of those actions on the environment. Mineral activities, with the exception of mineral patent applications, are subject to this law. Wildlife and fish values must be considered during the interdisciplinary analysis, including any long-term, offsite, or cumulative effects on the wildlife resource.

- **The Federal Water Pollution Control Act of 1972.**[5] This act concerns the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. It specifies that water quality must be sufficient for use by fish and wildlife, and requires the Environmental Protection Agency to develop regulations establishing Federal standards for control of pollutant discharge. Therefore, any mineral activities that involve water must be evaluated in relation to chemical and biological standards for fish and wildlife habitats.

- **The Clean Water Act, as amended in 1972.**[6] This act specifies the development of the best management practices (BMP) for water resources. With respect to mining activities, Federal agencies cooperate with the States to control mining and construction sources of water pollution.

State water quality laws and regulations usually provide the enforcement authority for water quality regulations; the implementation of the Clean Water Act is accomplished through cooperative agreements between the States and the Federal government. In mineral activities, the Forest Service biologist should examine the cooperative agreements with the States to identify the applicable BMP. The BMP's are the management guidelines for aquatic and riparian habitats in relation to water quality.

- **The National Forest Management Act of 1976 (NFMA).**[7] NFMA states that considerations of wildlife and fish resources must be included in the interdisciplinary land-management planning effort to identify land suitabilities for resource management, including minerals management. This act directs the Forest Service to provide for a diversity of plant and animal communities. The effects of mineral activities on wildlife habitat diversity are an important element in project evaluations. Monitoring the effects of minerals activities on wildlife and fish habitats is also a Forest Service responsibility.

In addition, NFMA states that special management attention is required in riparian habitat—land areas adjacent to bodies of water. The act prohibits management practices causing detrimental changes in water temperature or chemical composition, water blockages, and deposits of sediment within those areas if such occurrences seriously or adversely affect water condition or fish habitat.

LAWS AND REGULATIONS GOVERNING MINERALS AND MINING

- **The General Mining Law of 1872.**[8] This law is still in force today. The 1872 law declared "all valuable mineral deposits in lands belonging

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[4] U.S. Laws, Statutes, etc. Public Law 91-190 (S. 1075), Jan. 1, 1970. National Environmental Policy Act of 1969. An act to establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes. In its United States Statutes at large. 1969. Vol. 83, pp. 852-856. U.S. Gov. Print. Off., Washington, D.C. 1970. (42 U.S.C. 4321, 433-4335, 4341-4347).

[5] P.L. 92-500 (86 Stat. 816; 33 U.S.C. 1251).

[6] P.L. 95-217 (91 Stat. 1566; 33 U.S.C. 446 et seq.).

[7] U.S. Laws, Statutes, etc. Public Law 94-588 (S. 1075), Oct. 22, 1976. National Forest Management Act of 1976. In United States code congressional and administrative news. 94th Congr. 2d sess., 1976. Vol. 2, p. 2949-2963. West Publ. Co., St. Paul, Minn. (1976).

[8] Act of May 10, 1872. (17 Stat. 91).

to the United States...to be free and open to exploration and purchase." It authorized placer and lode mining claims to be located by a procedure that is largely unchanged to this day. The act also requires that not less than $100 worth of work be performed on each claim per year.

The 1872 Mining Law permits an individual to, upon discovery of a valuable mineral deposit, locate a claim. In order to keep the claim in good standing the claimant must perform $100 worth of work a year. An individual may locate as many claims as desired as long as the land is not withdrawn and the person abides by the provisions of the mining law. In the case of placer claims, the individual is limited to a 20-acre claim. However, a group of individuals may join together and locate an association placer claim, which encompasses more than 20 acres. As many as eight individuals may participate in the location of a single association placer claim, which encompasses 160 acres (20 acres per participant). If the claim remains unpatented, the claimant possesses the right to extract and remove the locatable minerals, but he cannot sell the mineral material from the claim nor have full title to the property.

Later modification of the 1872 Act excluded certain minerals. Today, the 1872 Act concerns hardrock minerals (gold, silver, zinc, etc.) on public domain lands.

- **The Mineral Leasing Act of February 25, 1920.**[9] The Mineral Leasing Act of 1920 provided that deposits of coal, phosphate, oil, oil shale, gas, and sodium could be acquired through a leasing system. This law specifies, among other things, royalty rates, rental rates, lease size, and terms required for each kind of leasable mineral. The law also provides for issuance of prospecting permits prior to lease issuance and competitive bidding for certain deposits.

Generally, with respect to National Forest System lands that were removed from the public domain to create the National Forest System, the Bureau of Land Management, under an interdepartmental agreement, requests Forest Service *recommendations* on leasing decisions and on stipulations and conditions to attach to leases. Provisions are included that allow the incorporation of lease stipulations to protect surface resource values.

- **The Mineral Leasing Act for Acquired Lands of August 7, 1947.**[10] This act authorizes mineral leasing on acquired lands—lands the Federal Government bought from private landowners for a specific purpose. Leases on acquired lands may only be issued with the consent of the Secretary of Agriculture and are subject to conditions that insure the lands are used for the purpose for which they were acquired. Leasable minerals covered by this act include coal, phosphate, oil and gas, oil shale, sodium, potassium, and sulfur. In addition, minerals covered by the 1872 Mining Law, as amended, on public domain lands are subject to the 1947 Act on acquired land. This law is administered through the Bureau of Land Management.
- **The Materials Act of 1947.**[11] This act authorizes disposal of salable materials including, but not limited to, sand, stone, gravel, and common clay on public lands through a sales system. If the appraised value of the material exceeds $1,000, it must be disposed by competitive bidding. The law also provides for free use of material by government agencies, municipalities or nonprofit organizations, if the material is not to be used for commercial purposes. Disposal of these minerals is handled through the agency administering the land.
- **The Multiple Use Surface Act of 1955.**[12] This act provides that the Forest Service has the right to manage and dispose of the vegetative surface resources and to manage other surface resources, including wildlife habitat, on valid mining claims. Under this act, common varieties of sand, gravel, cinders, pumice, pumicite, and clay were removed from the category of locatable minerals and placed under the Materials Act of 1947.

Federal regulations 36 CFR 228 direct that exploration and mining activities be conducted so as to minimize adverse environmental impacts. A Notice of Intent to Operate must be

[9] The Act of February 25, 1920; 41 Stat. 437.

[10] Act of August 7, 1947; 61 Stat. 913.

[11] Act of July 31, 1947; 61 Stat. 681.

[12] Act of July 23, 1955; 69 Stat. 367.

filed with the respective District Ranger prior to conducting an activity that might disturb the surface resources. The operator is required to reclaim all lands affected by the mining operation, including wildlife habitat.

- **The Federal Coal Leasing Amendments Act of 1976.**[13] The act gives the Forest Service consent authority for coal leasing and operating plan approval on National Forest System lands. The act states that no coal leases will be issued unless the lands have been included in a comprehensive land-use plan and the development of the coal resource is compatible with the established plan.

- **The Federal Land Policy and Management Act of 1976 (FLPMA).**[14] One provision of this act requires mining claimants to record their location notices and their annual assessment work with the Bureau of Land Management in addition to the local county recorder as required by State law and regulation. These records, for the first time, provide an up-to-date, accurate listing of mining claims data. This act also contains mineral withdrawal provisions.

CONCEPTS RELATED TO MINERAL LAW

Familiarity with the precise wording and meaning of mineral law is one aspect of the legal foundations of minerals-area management. The role of the Forest Service in mineral activities on National Forest System lands depends upon the status of the land and mineral rights. Hence, Forest Service authority over mineral development is not all-inclusive, nor is it identical from one case to another. To understand the role of the Forest Service in minerals management, the biologist should have a working knowledge of the following concepts that govern Forest Service actions:

- **Mineral estates.** Because of the complex ownership situations that exist in regard to minerals and shared ownership or overlapping authorities, considerable coordination among government agencies is necessary if the minerals management program is to be effective. For example, various Federal and State agencies may have jurisdiction over one or more segments of the development. Hence, involved agencies must be included in certain phases of the planning and/or decision-making process.

Split ownership of surface and mineral estates occurs when one party has jurisdiction over the mineral estate and another has jurisdiction over the surface rights. The law allows mineral and surface rights to be bought and sold separately. Therefore, different parties may each have rights to the same piece of property.

For example, the Federal Government bought a great deal of land, especially in the Eastern States, without obtaining ownership of the minerals under the surface. Rights to some of these minerals remain "outstanding" or "reserved" to private owners, and these individuals may remove the minerals at any time, subject to the surface management requirements of Federal and State laws.

Reserved rights mean that the party conveying land to the United States retains ownership of all or part of the mineral rights. The exercise of these rights is conditioned by the Secretary of Agriculture's "Rules and Regulations," which are sometimes attached to and made a part of the deed, and by State laws. This provision gives the Federal Government some surface control authority.

In contrast, outstanding rights mean that all or part of the mineral rights are held by a third party—*not* the party conveying the land to the United States. No Secretary's Rules and Regulations may be applied, because the third party is not an active participant in the conveyance of land to the Government, and duties and restrictions cannot be imposed without this party's consent. The exercise of the mineral rights is conditioned by the specific language conveying (or reserving) the mineral rights and by legal interpretations. The net result of outstanding mineral rights is that possibilities for surface control authority vary from zero to comprehensive, depending upon the type of title conveyance, legal interpretation, and existing State laws (see table 3).

- **Land acquisition considerations.** The manner in which the land was acquired affects Forest Service authorities. Lands are classified as either public domain or acquired, and the dis-

[13] Act of August 4, 1976; (90 Stat. 1083; 30 U.S.C. 181-287).

[14] Act of October 21, 1976; (43 U.S.C. 1701 (note)).

tinctions between the two classifications determine Forest Service authority and responsibility regarding mineral development.

Generally, public domain lands, unless specifically withdrawn, are open to mineral exploration and development under the U.S. Mining Law of 1872, as amended. On the other hand, acquired lands are open to leasing under the 1947 Acquired Lands Act.

The Forest Service generally has greater authority over minerals on acquired lands than on public domain lands, because the authority to grant consent for development of certain resources exists. Consent can be withheld, based on valid reasons, and if consent is given, stipulations can be attached to the license, permit, or lease issued by the Department of the Interior.

Based on the 1872 Mining Law, public domain lands, unless withdrawn from mineral entry, are open for mineral exploration and development. If a mineral is classified as leasable (see below), the Forest Service can recommend or require that stipulations be attached to the lease.

- **Disposal of Federally owned minerals.** All minerals owned by the United States that are available for exploration and development are disposed under one of three categories—locatable minerals, leasable minerals, and salable minerals.

Locatable minerals are mineral deposits on "open" public domain lands that were originally subject to disposal under the 1872 Mining Law. Those minerals that were not excepted in later legislation remain subject to this law. Gold, silver, and tin are among minerals classified as locatables.

For locatable minerals, specific regulations outlined in the Secretary of Agriculture's regu-

Table 3.—*Mineral authority matrix*[1]

Circumstance	Responsible Agency		
	USDA Forest Service	Bureau of Land Management	U.S. Geological Survey
Locatable minerals			
1. Surface management (as directed by 36 CFR 228) includes notice of intent, operating plan on public domain lands	X		
2. Mining claim recordation and patent compliance		X	
3. On acquired lands	X	X	
Leasable minerals			
1. Lease issuance on both acquired and public domain lands		X	
2. Recommendations and evaluation of lease applications on public domain lands	X		
3. Consent authority for coal on public domain lands	X		
4. Consent authority on acquired lands	X		
5. Processing of prospecting permits	X		
6. Evaluation of operating plans	X		X
7. Mining operations			X
8. Access on NFS lands	X		
Salable minerals			
All activities	X		

[1] For more detailed information see FSH 2809.11, "Land Manager's Handbook on Minerals Management."

Table 4.—*Federal laws and regulations governing minerals and wildlife*

Requirements, Responsibilities, and Procedures	Endangered Species Act	Bald Eagle Protection Act	Migratory Bird Treaty Act	NEPA	NFMA	Water Pollution Control Act	Clean Water Act	Fish and Wildlife Coordination Act	Executive Order 11988*	Executive Order 11990*	Mining Law of 1872 (36CFR228)
U.S. Fish and Wildlife Service responsibilities	X	X	X								
Environmental analysis requirements				X							
Planning requirements					X						
Water quality and wetlands requirements						X	X	X	X	X	
Locatable mineral procedures											X
Salable mineral procedures											
Leasable mineral procedures											
• Other than commodities listed below											
• Oil and gas											
• Coal											
• Geothermal											

*Not discussed in text.

lations (36 CFR 228 [formerly 36 CFR 252])[15] must be adhered to when mining activity is proposed on National Forest System land. The regulations provide that:

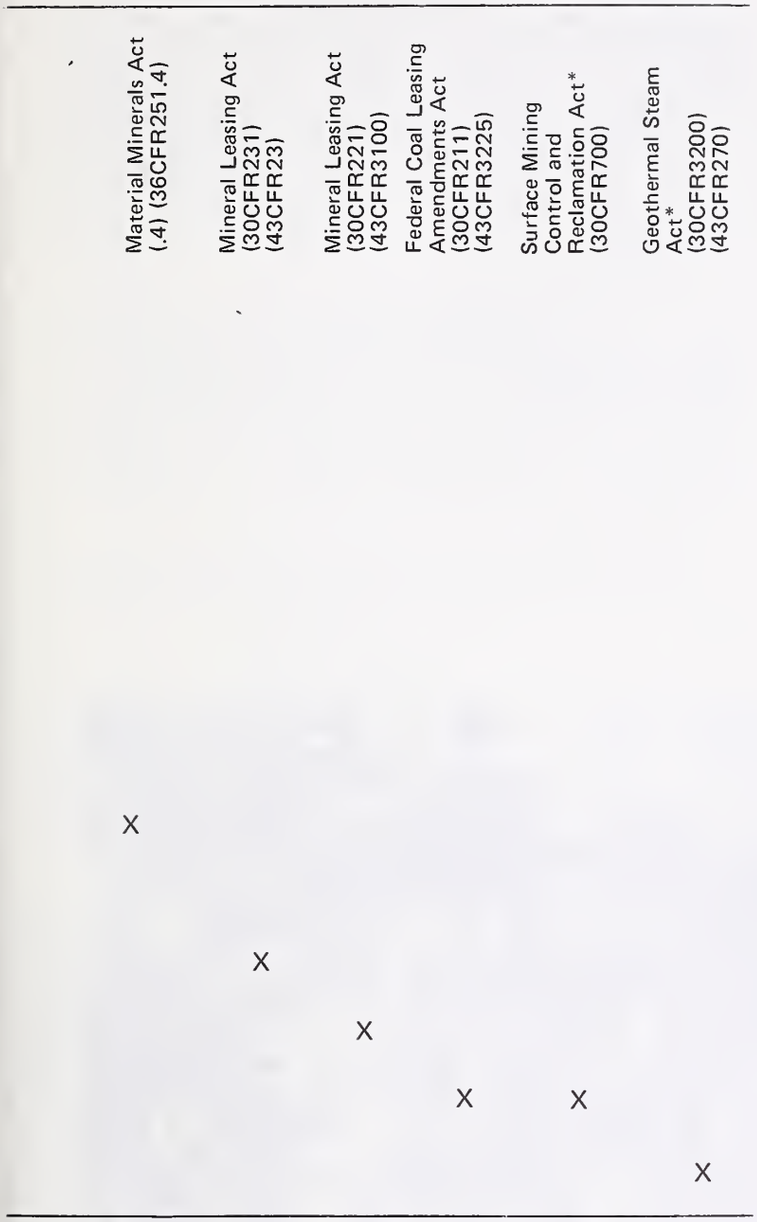
1. A "notice of intention to operate" must be filed with the local Forest Service office for proposed prospecting or mining operations covered under the 1872 Mining Law when the activity might cause a disturbance to surface resources on National Forest System lands. If the authorized Forest Service officer determines that the operations will cause a significant disturbance to the environment, the operator must submit a proposed plan of operations.

2. All operations must be conducted, insofar as possible, to minimize adverse environmental impacts on the National Forests.

3. The plan of operations must detail the steps the operator will take for feasible rehabil-

[15] National Forest Mineral Resources—USDA rules on prospecting, exploration, and mining procedures: effective 9-1-74 (36 CFR 228).

as they relate to public agencies' actions



itation when the prospecting or mining is completed.

4. The operator may be required to furnish a bond commensurate with the expected costs of rehabilitation.

5. The plan of operations must be approved by the authorized Forest Service officer before any operations are conducted.

Leasable minerals have been excepted from the 1872 Mining Law by:

1. Specifying certain minerals by name (for example, geothermal resources).

2. Providing a leasing system for minerals on land with acquired status.

Salable minerals are available for disposal under a separate system, primarily because of their widespread occurrence. These minerals are classified by statute as "common variety" minerals. Examples are gravel and stone. Minerals of the same type that have some property giving them distinct and special value are considered "uncommon varieties" and are disposed of under the General Mining Law of 1872 as amended. The character of the deposit determines whether the mineral is classified as a locatable or a salable.

WILDLIFE LAW

Wildlife management on public lands administered by the Forest Service is complicated by the fact that many agency responsibilities and authorities are involved (see table 4). Generally the State, through the State fish and wildlife agency, has the responsibility for management of wildlife populations. The Forest Service, as the land-management agency, is responsible for the management of wildlife habitat on lands it administers. A third agency, the U.S. Fish and Wildlife Service, is also involved because of responsibilities for enforcing Federal legislation involving threatened and endangered species and migratory species. Wildlife management on Forest Service-administered lands is therefore often a joint effort among these three agencies, and its success is contingent upon interagency coordination.

The basic authority for the State's management of the wildlife rests in the U.S. Constitution and the subsequent State ownership doctrine. State responsibilities include: (1) setting and administering hunting and fishing regulations; (2) enforcing State wildlife laws and providing regulations; (3) basic inventory and research; and (4) providing expertise on wildlife population management. Close coordination with the State agency biologist is an important step in the analysis and evaluation regarding mineral activities.

The U.S. Fish and Wildlife Service is the lead agency administering the Endangered Species Act. All Federal actions that may affect a Federally listed threatened or endangered species

must be reviewed by the U.S. Fish and Wildlife Service in a formal consultation process. The U.S. Fish and Wildlife Service also has responsibilities stemming from the Bald Eagle Protection Act of 1940, which involves protection of bald and golden eagles. The Fish and Wildlife Service also has responsibilities dealing with migratory species that cross state lines.

The following are several important wildlife laws:

- **The Endangered Species Act of 1973 (Amended 78, 79).**[16] Administered by the U.S. Fish and Wildlife Service, this act directs that actions authorized, funded, or carried out by a Federal agency must not jeopardize the continued existence of a Federally listed threatened or endangered species (fig. 8). A formal consultation process is established in which the Fish and Wildlife Service is consulted on Federal actions that may affect a threatened or endangered species. The Forest Service has the responsibility for evaluating proposed mineral activities on lands it administers to determine if such activities affect a Federally listed species. Any State-listed species will be handled in the same manner, except that formal consultation with the U.S. Fish and Wildlife Service is not required.
- **The Bald Eagle Protection Act of 1940.**[17] This act gives Federal protection to bald and golden eagles; the Fish and Wildlife Service is also responsible for the act's enforcement. Mineral activities that directly cause the abandonment or failure of a golden or bald eagle

[16] P.L. 93-205 (16 U.S.C. 1531 et seq.).

[17] P.L. 92-535 (1, 86 Stat. 1064; 16 U.S.C. 668-668d).

Figure 8. Federal laws provide for the protection of threatened and endangered species, such as the bald eagle.

nest site may be in violation of this act.

- **Migratory Bird Treaty Act of 1918.**[18] This act gives Federal protection to migratory birds and is enforced by the U.S. Fish and Wildlife Service. The Forest Service has the responsibility for evaluating proposed mineral activities on lands it administers to determine if such activities affect migratory birds.
- **The Anadromous Fish Conservation Act of 1965.**[19] The purpose of this act is "...to conserve, develop, and enhance the anadromous fishery resources of the nation that are subject to depletion from water-resource developments and other causes, such as mining. Water quality must also be maintained consistent with U.S. conservation commitments by international agreements...for the purpose of conserving, developing, and enhancing fish in the... Columbia River basin that ascend the streams to spawn...." The Secretary of the Interior makes recommendations to the Secretary of Health and Human Services concerning the elimination or reduction of polluting substances detrimental to fish and wildlife in interstate or navigable waters or their tributaries.

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[18] Act of July 3, 1918 (40 Stat. 755).

[19] Act of October 30, 1965, P.L. 89-304 (79 Stat. 1125 16 U.S.C. 757a-757f).

Chapter 3

WILDLIFE OBJECTIVES IN LAND-MANAGEMENT PLANNING

When the biologist is asked to evaluate a mining project, he needs a framework or perspective in which to do the evaluation. The laws, regulations, and concepts introduced in chapter 2 provide the legal framework; the land-management plan, or forest plan, also adds to the perspective.

The forest plan is important to the analysis of a specific mineral project because the plan establishes the goals, objectives, and standards for managing the National Forest. Although it is not site specific, the objectives established for the overall area are useful in the review of proposed activities. This chapter discusses the general land-management planning process and the manner in which minerals and wildlife are integrated into the process.

LAND-MANAGEMENT PLANNING

The forest plan is a land-management plan that outlines the most desired uses for specific land areas, keeping in mind that a primary role of the Forest Service is to manage surface resources. The procedures for developing this plan are listed in rules and regulations in the Federal Register (vol. 44, no. 181, 9/17/79). These rules and regulations detail the requirements of the National Forest Management Act of 1976 (NFMA), which specifies that all resources—such as wildlife, minerals, timber, and recreation—must be addressed in the plan.

A key element in the planning approach is the interdisciplinary (ID) team, a requirement of the NFMA. The act requires all pertinent specialists to work as a team in developing forest plans. NFMA specifically requires that ID teams, consisting of personnel who collectively represent diverse areas of resource knowledge, consider, analyze, and solve resource problems in an integrated manner. This is in contrast to a functional or multidisciplinary approach in which resource problems are separated, analyzed, and solved along disciplinary lines.

When the ID team is formed for the purpose of developing a land-management plan, members are directed by NFMA regulations to carry out 10 formal planning actions (fig. 9). Although NFMA regulations state that all resource values present on an area must be considered in the planning process, the remainder of this chapter discusses the coordination of two resources—wildlife and minerals.

MINERAL CONSIDERATIONS IN LAND-MANAGEMENT PLANNING

Mineral considerations in land-management planning are detailed in the previously referenced "Minerals Planning Handbook." In summary, mineral inputs are in response to the five items listed in the NFMA regulations (36 CFR 219.12(J)):

1. Active mines within the area of land covered by the forest plan;
2. Outstanding or reserved mineral rights;
3. The probable occurrence of various minerals, including locatable, leasable, and common variety;
4. The potential for future mineral development and potential for withdrawal from development; and
5. The probable effect of renewable resource allocations and management on mineral resources and activities, including exploration and development.

The minerals program representative to the ID team is generally the person responsible for

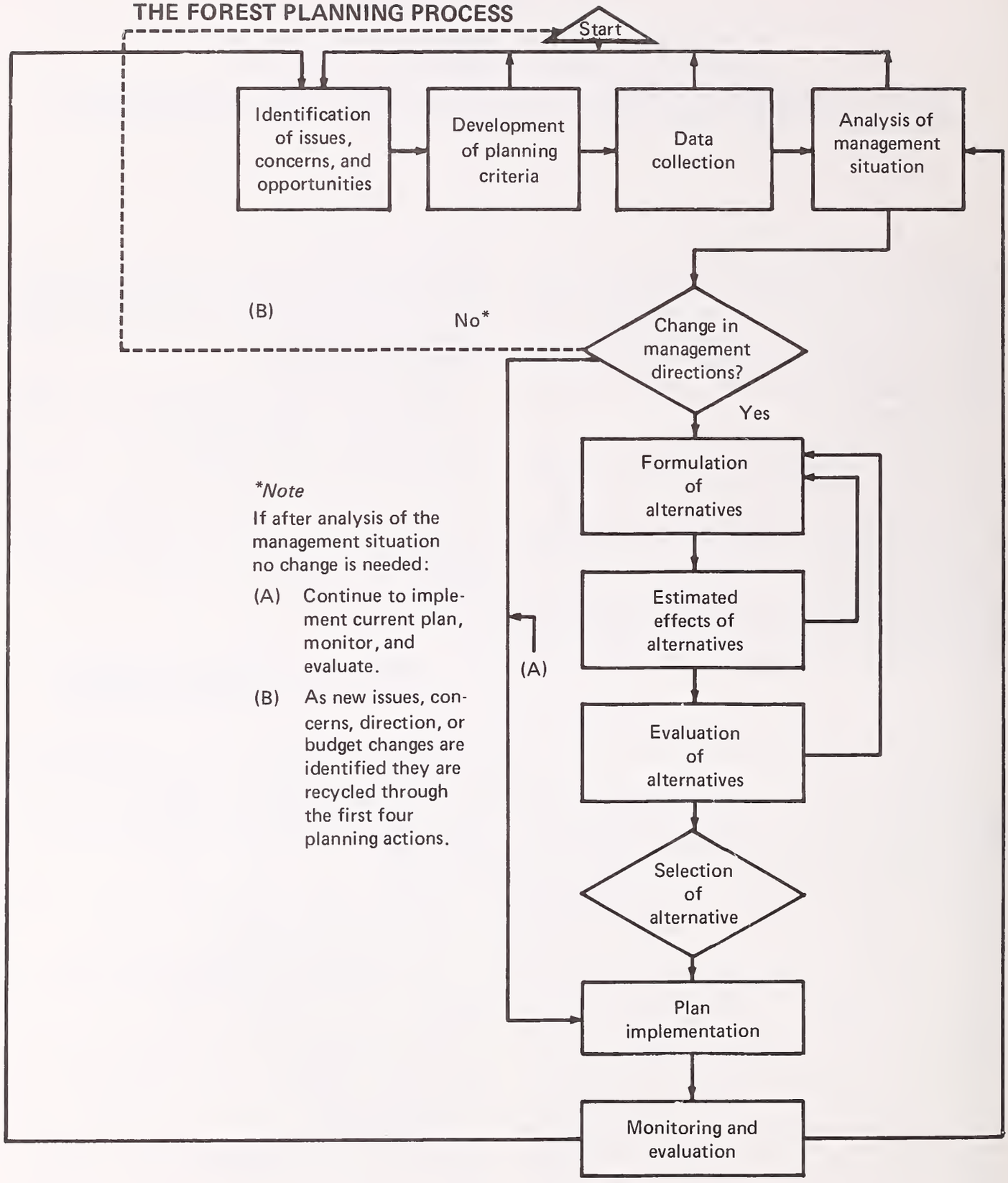

Figure 9. The land-management planning process.

Figure 10. Biologists insure that important wildlife habitats, such as this elk calving area, are considered in the forest plan.

providing information about the mineral resource and for representing the needs of the mineral resource during the planning effort. This person provides forecasts of expected mineral activity on, and adjacent to, the Forest. The forecasts estimate the type, magnitude, and duration of mineral activities expected in the planning area and provide the best information available as to when and where the mineral activity is expected. The estimates are useful for focusing the attention of the ID team (including the biologist) on specific land areas where mineral activity is expected.

WILDLIFE REQUIREMENTS IN LAND-MANAGEMENT PLANNING

The NFMA directs that certain wildlife values be represented in the forest plan. When the biologist participates in land-management planning, he works with other resource specialists to make sure that these wildlife requirements are provided for (fig. 10). The NFMA regulations require that wildlife habitat goals be identified to maintain viable populations of all existing native vertebrate species in the planning area and to maintain and improve habitat of management indicator species. A viable population is one that has adequate numbers and dispersal of reproductive individuals to insure the continued existence of the species population on the planning area. Management indicator species that represent all existing native vertebrates in the forest being planned must be selected. According to NFMA regulations, management indicator species are species identified for land-management planning purposes that may include: (1) threatened and endangered plant and animal species in the area; (2) species with

Figure 11. On-the-ground discussions of industry's plans and wildlife needs are an important step in the planning process.

special habitat needs that may be influenced significantly by planned management programs; (3) species commonly hunted, fished, or trapped; and (4) species whose population changes are believed to indicate effects of management activities on other species found in the area.

To carry out NFMA directives the biologist identifies the size of the area upon which the wildlife goals can be met. Objectives for wildlife on suitable habitat units are prepared for all of the forest's wildlife habitat acres. Objectives are also stated that address the minimum acceptable conditions assuring population viability. In addition, management practices, by ecosystem, are included in the forest plan.

Objectives may vary by planning alternative, each responsive to a different management emphasis. The biologist determines the minimum portion of the forest suitable for application of the minimum acceptable habitat conditions for management indicator species. If the habitat quantities and qualities are underrepresented, population viability would not be maintained, and legally required conditions for wildlife would not be provided.

PROJECT IMPLICATIONS

When an operating plan for a mineral project is submitted to the Forest Service, the forest plan provides objectives and guidelines to consider in making recommendations about the operator's plan. Goals, objectives, and standards that may apply include:

1. Area-specific population and habitat objectives that are compatible with Federal laws, such as the NFMA and the Endangered Species Act, management emphasis of the forest plan, or other approved land-management plans.
2. Minimum acceptable conditions for wildlife.
3. Management practices by ecosystem.

Forest Service representatives can meet with industry officials before mineral development begins to examine the objectives for wildlife documented in the forest plan, and negotiate reasonable standards for protecting wildlife (fig. 11). The nature of the negotiations may differ, depending on whether the minerals are classified as locatable or leasable.

When locatable minerals are involved, the authority of the Forest Service provides for the protection of nonmineral values against unnecessary or unreasonable damages from mining activities. The authorities are intended to provide protection without unreasonably inhibiting or restricting the activities of prospectors and miners. When leasable minerals are involved, the Government has discretionary authority over issuance of leases. If conflicts between wildlife objectives and mineral activities cannot be resolved through cooperative efforts, legal action may be required.

Chapter 4

PHASES OF MINERAL ACTIVITIES

This chapter explains the phases of mineral development and describes some of the changes that may occur to the surface resource. Based on such an understanding, the biologist—as either a member of, or consultant to, the Forest Service interdisciplinary team that reviews industry's proposed plans—can recommend to the land manager ways to meet wildlife needs while considering mineral and other resources.

For each classification of minerals (locatables, leasables, salables) a brief description of the legal basis for the mineral classification is given, and an explanation, by phase of mining, of expected industry activities is provided. The points covered are, of course, generalizations, and activities will vary by project. Note that under the "salables" section, only the legal basis for the classification is discussed. This is because the development and extraction processes of developing a "salables" mineral project is very similar to a "locatables" project and because new guidelines and regulations are being promulgated for salables. Thus, for specifics with regard to salables, refer to locatables.

LOCATABLE MINERALS

Legal Basis

While locatable minerals are frequently thought of as hardrock minerals, the Mining Law of 1872 actually puts locatables in a broader perspective. Under this law, a locatable mineral is one that is: (1) recognized as a valuable mineral by standard authorities; and (2) is found on public land open to mineral entry in quality and quantity sufficient to render a claim valuable because of mineral content.

Later laws excluded some leasable and salable minerals from this broad definition; however, any mineral not excluded is considered to be locatable. Some specific locatable minerals include gold, silver, lead, tin, and copper. Generally, all valuable metallic mineral deposits are locatable, as are a large group of nonmetallic minerals that have been designated locatable by the Department of the Interior, a Federal or State court, or Congressional legislation. These include borax, feldspar, and gypsum.

Phases of Mining

Generally, locatable mineral deposits are developed through a sequence of mining steps that result in extraction of the mineral and reclamation of the land. A discussion of each step in terms of industry activities follows. Note that the phases of mining described are general, rather than specific to any one locatable mineral.

Furthermore, although the presentation makes the mining phases appear clear and distinct, in actual situations they are not so well-defined, often overlap, occur over extended periods of time, and may include periodic intervals of inactivity. When involved in a mining project, the biologist must possess a working knowledge of the specific mining practices used, as well as the laws and regulations in effect.

While reclamation is discussed as part of the production phase of mining, it may and should occur upon the completion of the surface-disturbing activity on a given land area. For example, when a large, open-pit surface mine is proposed, plans for final land configuration and reclamation are included in the approved operating plan. If an operating plan is necessary, a reclamation plan and bond are required. (In the following discussion, the term "operating plan" is used in a general sense to refer to mining plans and plans of operation.)

Prospecting

Prospecting is a general term for a group of activities that range from regional appraisals to detailed reconnaissance. It can be defined as the search for a mineral prospect—an area that is a

potential site of a mineral deposit based on preliminary exploration.

During prospecting, the area under study can vary from thousands of square miles to one as small as several hundred acres. The following industry activities may occur during prospecting:

1. Basic prefield research projects.
2. Photogeology and remote sensing projects.
3. Geochemical projects (stream sediments, soil samples, and so on).
4. Geologic mapping and sampling (surface and subsurface).
5. Geophysical projects (on-the-ground, underground, and airborne).
6. For hardrock, digging shallow pits and trenches and perhaps surface and underground drilling.
7. Travel over existing roads and off-road vehicle (ORV) use.

Most forms of prospecting are non-surface disturbing or result in only minor impacts to surface resources. These activities are usually undetectable after a few rainstorms or, at most, a couple of growing seasons. In fact, prospecting for locatable minerals may go unnoticed by the Forest Service until claims are staked or the Ranger District is contacted by company representatives. Very rarely is a notice of intent or operating plan required for these prospecting activities.

Resource conflicts or disturbances typically associated with prospecting activities include:

1. Access. Most access involves use of existing roads and trails and/or use of off-road vehicles. The Forest Service may also receive requests to use roads located in closed areas, such as RARE II areas.

2. Helicopter use. In remote regions or in areas regarded as sensitive because of wilderness or wildlife values, helicopters are commonly used and generally result in minimal surface impacts for helipad construction. However, conflicts between recreationists and industry may result when helicopters are used in or near wilderness areas and/or high recreational-use areas.

Exploration

Exploration is the process of investigating target areas in order to discover if an economically viable mineral deposit exists, and if so, to establish its nature, shape, and grade. Exploration is the transitional stage between the prospecting and development stages.

Exploration activities may range from detailed surface appraisal to dimensional sampling. Project-area size depends upon the mineral commodity being sought and can vary from several thousand acres to less than 20 acres. The following summarizes activities that may occur during this phase of mining:

1. Compilation and evaluation of prospecting data.
2. Detailed photogeology projects, including remote sensing.
3. Detailed geochemistry projects, which may require soil sampling on a closely spaced (50-100 ft) grid pattern.
4. Detailed geophysical projects, including drilling test holes for subsurface geophysical studies.
5. Detailed surface mapping and sampling.
6. Detailed underground mapping and sampling.

Figure 12. Considerable access road construction may be needed during exploration.

7. Subsurface mapping and sampling by various drilling methods.

8. Excavation of drill pads, pits, trenches, adits, and shafts.

9. Travel over existing roads, ORV use, reconstruction of existing roads or trails, and construction of new access roads (fig. 12).

10. Additional claims staking.

11. Bulk sampling for metallurgical testing (surface and/or subsurface).

Surface disturbances resulting from exploration activities depend on the method and equipment used and the size and type of the target area. Surface disturbances may be widespread during exploration activities for a number of reasons: The target area is not yet clearly defined; access problems exist; topography creates a barrier; and the exploration methods used result in widespread disturbances.

As exploration activities intensify, impacts on other resources generally increase. However, the surface effects from these activities can usually be reclaimed so that:

1. Unnecessary erosion is prevented.
2. Visual impacts are reduced.
3. Disturbed lands are reshaped and converted back to a productive status.
4. Safety hazards are eliminated.

During exploration, contact between industry and the Forest Service increases as the project expands. In the early stages of exploration, notices of intent, exploration permits, and operating plans are routinely handled by the land manager. Most industry contacts are of an informational nature involving questions concerning Forest Service policy, regulations, and requests for information to assist the operator in complying with Forest Service management policies and regulations.

Feasibility Studies/Operating Plan

Upon completion of exploration, industry determines if the property(ies) warrants further development. If it does, the rate and period of development are considered. Future development will proceed in accordance with overall company plans, cash-flow limitations, market projections, and so forth. If the evaluation is positive and the operator decides to proceed to the development phase, an operating plan will be filed with the appropriate administrative agencies.

Regulations require an operator conducting prospecting, exploration, development, production, or mineral processing operations on National Forest System lands to file a notice of intent and/or operating plan when the proposed work will cause a significant disturbance to the surface resources. Development operations normally cause significant surface disturbance and therefore require an approved operating plan.

The scope of the operating plan varies with the size, location, and complexity of the activity. Its size may range from a few form-filled pages to a lengthy document supported by several volumes of technical memoranda. Basically, the plan identifies the claimant and describes the operator's proposed operation, access routes, waste disposal plans, environmental protection measures, and reclamation program.

To develop a major environmental analysis, baseline data must be collected; generally, this is the responsibility of the Forest Service, although at times the industry may assist in data collection through third-party arrangements. Information gathered includes, but is not limited to:

1. The site's geologic characteristics.
2. The type of soil and vegetation present on the site prior to mining.
3. Wildlife and fisheries data.
4. Cultural resources.
5. Water (surface and subsurface).

Baseline data are used as a yardstick to measure the success of reclamation and compliance with the approved operating plan.

Before industry can proceed with development, the necessary reclamation bond must be deposited with the Forest Service and the operating plan must be approved by the authorized officer(s). If and when necessary, industry may submit amendments modifying the plan, or the Forest Service may require industry to update the operating plan to satisfy regulatory requirements. Such amendments may be made throughout the mining process.

The Forest Service's heaviest involvement in the mining project probably comes during the review and approval process for the operating plan and subsequent compliance inspections. For example, during operating-plan review, the Forest Service prepares an Environmental Assessment (EA) based on the plan, or if neces-

sary, an Environmental Impact Statement (EIS).

Forest Service staff members must understand their responsibilities and regulatory authority relative to the type of mineral being developed. For example, when the Forest Service receives an operating plan for locatable minerals, 36 CFR 228 (formerly 36 CFR 252) regulations require that the Forest Service promptly acknowledge its receipt to the operator, and within 30 days of such receipt, the authorized officer must evaluate the operating plan and:

1. Notify the operator that the plan is approved;
2. Notify the operator that the proposed operations are such as not to require an operating plan;
3. Notify the operator of any changes in, or additions to, the operating plan deemed necessary to meet the purpose of the regulations;
4. Notify the operator that the plan is being reviewed but that more time, not to exceed an additional 60 days, is necessary to complete the review setting forth the reasons why additional time is needed; or
5. Notify the operator that the plan cannot be approved until a final Environmental Impact Statement has been prepared and filed with the Council on Environmental Quality. If the Forest Service land manager determines an Environmental Impact Statement is required, the Forest Service is responsible for preparing the EIS.

Development

Development can be defined as the preparatory work necessary to facilitate the extraction and/or processing and transporting of the proven mineral reserve. Note that production may or may not accompany development. Indirectly, development activities occur throughout the life of many mineral operations. Hence, development and production operations frequently take place at the same time on different parts of a project.

Industry activity during the development phase includes, but is not necessarily limited to, opening up the deposit for underground access and installing surface and subsurface facilities and equipment needed for mineral extraction, processing, and transportation (fig. 13).

Following or during development work, the operation may move into the production phase. However, the company may decide to delay production. Reasons for delaying might include: (1) additional property, water rights, surface rights, and so on, may need to be acquired; (2) better market conditions may be anticipated; (3) equipment or personnel problems; (4) contract problems; (5) cash-flow considerations; or (6) an assortment of unrelated problems.

Development work is generally a transitional stage between exploration and production activities, but often continues after production has begun. Development usually causes the most surface disturbance, but the acreage impacted is generally well-defined and limited to the area of future operations. As it does for all surface-disturbing mining activities, the Forest Service must monitor the project during development to make sure the operating plan is adhered to, and to determine if any changes are needed in the plan.

The Forest Service biologist should also be aware that as industry's exploration staff leaves and construction workers enter the area, people-related impacts will likely increase because of the larger numbers of people using the forest. To establish a communication link, the biologist should become acquainted with construction and mining crews.

Production/Reclamation

Because production and reclamation may occur simultaneously, they are discussed together here. However, reclamation should occur whenever the surface-disturbing operations are completed for any land area.

Production: Production (or mining) is the process of extracting and/or processing and transporting mineral products from the site to market. Hardrock minerals are extracted by underground, open pit, or placer mining methods. The underground method causes the least amount of surface disturbance.

After the mineral has been extracted, it is milled and then transported to a smelter for additional processing. The mill may or may not be located on the property. In many cases, the raw ore is sent to a custom mill. Production may continue for 20 years or more and may involve periodic openings and closings of the operation for various reasons.

Normally, little additional surface disturbance occurs during the production stage, except within the actual operating, waste-disposal, or tailing-

Figure 13. Facilities needed to operate the mine are installed during the development phase.

pond areas. Thus, Forest Service work will essentially involve monitoring industry activities. However, operating plan modifications may be necessary in some cases.

Reclamation: Reclamation is the process of returning disturbed land to a predetermined form and productivity standard. Reclamation is the responsibility of the operator, and the company's efforts must meet the requirements set forth in the approved reclamation plan. If they do, the Forest Service will release the reclamation bond, but if not, and the company refuses to redeem its reclamation responsibilities, the Forest Service will use the bond to complete the agreed-upon reclamation. Reclamation activities include:

1. Shaping and grading spoils.
2. Replacing stockpiled topsoil.
3. Fertilizing and planting a vegetative cover.
4. Mitigating water and air pollution.
5. Protecting selected animal species.
6. Reclaiming abandoned transportation and utility corridors.
7. Reclaiming tailing dams and waste-disposal embankments, and closing off mine drainages.
8. Re-establishing natural drainages whenever possible. The cost and complexity of reclamation procedures vary greatly depending on the extent of the operation and the period of time required to achieve desired results.

Postmining

Postmining is the period following mineral extraction and initial reclamation work. During this time, the mining operator is required to monitor the success of the reclamation program and re-treat problem areas. Road reclamation may also occur during this time. The object of postmining monitoring is to assess whether the reclamation goals agreed to in the operating plan have been reached. If so, the operator is released from the reclamation bond.

The length of time during which the operator is responsible and liable for the success of the reclamation effort varies, but often continues for several years after the last year of augmented seeding, fertilization, irrigation, or other work. Generally, the time period is stated in the operating plan. Once released from the bond, industry activities cease on the site.

One note: Temporary shutdown of mining operations may also occur. This could happen if, for example, the operation were endangering life or irreversibly damaging surface resources. In these cases, reclamation work is performed to

Figure 14. Helicopters are commonly used during preliminary investigation.

Figure 15. Vibrosis trucks, or "thumpers," are used to shock the earth to determine oil-bearing formations in oil and gas exploration.

correct the problem, after which the operation may reopen.

LEASABLE MINERALS

Legal Basis

Under the Mineral Leasing Act of 1920, certain minerals were withdrawn from location (as provided for by the Mining Law of 1872) and were placed under the Leasing Act. This act provides for mineral development through prospecting permits and leases, rather than claims-staking. No permanent rights can be acquired from the U.S. Government; instead, only the right to explore for and mine the specific leasable mineral covered by the lease or permit is granted.

These leasable minerals, as designated by the 1920 act, include: oil, gas, coal, oil shale, sodium, potassium, phosphate, native asphalt, solid or semisolid bitumen, bituminous rock, oil-impregnated rock or sand, and sulfur in Louisiana and New Mexico. Oil and gas are generally thought of as the most common minerals designated as leasables.

Phases of Mineral Activity

Depending on the type of leasable mineral under consideration, the phases of mining will vary. For example, coal and phosphate are mined similar to hardrock minerals; however, oil and gas are explored for and produced by drilling and pumping. The following discussion focuses on the steps involved in oil and gas exploration, development, and production since they are the most common minerals designated as leasables. Again, it should be remembered

Figure 16. Blasting effects during seismic activity can temporarily affect wildlife use patterns.

that these are general phases; they will vary from mineral to mineral, and the phases may overlap. However, the industry activities covered will usually occur at some point in leasable-minerals development.

Preliminary Investigation/Mineral Leasing

Preliminary investigation for oil and gas can be defined as the search for environments favorable to the accumulation of oil and gas. The intent of preliminary investigation is to determine whether an area warrants more detailed exploration.

During preliminary investigation, the area under study can vary from thousands of square miles to an area as small as several hundred acres. The following industry activities may occur during this phase:

1. Airborne surveys (fig. 14).
2. Geochemical surveys.
3. Geologic surveys, mapping.
4. Geophysical surveys, including the explosive methods, the thumper method, the vibrator method, gravity, and other methods (fig. 15, 16).

If preliminary investigation identifies an area that warrants more detailed study, a lease is normally acquired. Generally, the oil company acquires a lease prior to much surface disturbing work. The operator applies for the lease from the State office of the BLM, or in the Eastern United States, the Eastern States Land Office of the BLM. Before issuing a lease for National Forest System lands, however, BLM sends the application to the Forest Service for recommendation or consent, depending upon the status of the land (public domain or acquired) and the mineral commodity (coal, geothermal, etc.).

When leases are applied for, the Forest Service is involved in the evaluation through a memorandum of understanding between the

Departments of Agriculture and Interior. The Forest Service assesses possible effects of the development activity on other resources and then makes recommendations concerning the lease. An important outcome of the Forest Service review is the identification of specific surface protection measures, which are attached to the lease as stipulations. Stipulations are attached to all leases (standard stipulations have been developed for some commodities). In some cases, where unique surface situations exist, special stipulations are required or are included as part of the lease terms.

Once a lease is issued, the U.S. Geological Survey supervises onsite operations through a cooperative agreement with the Forest Service, which provides surface-resource information for planning and administration purposes. By regulation, the USGS is directly responsible for the mineral operation itself while the Forest Service retains administrative authority in emergency situations, such as oil spills, that could endanger other resources.

Exploration

Exploration for oil and gas is the process of further studying target areas in order to discover if an economically viable deposit (reservoir) exists, and if so, to establish its nature, shape, and potential production capabilities. Exploration is transitional from preliminary investigation; however, some preliminary investigation activities may continue, but the area of interest is usually smaller.

The following summarizes industry activities that may occur during this operational phase:

1. Stratigraphic tests, which involve drilling relatively shallow holes to supplement seismic data.

2. Lease acquisition or additional lease offers to firm up the amount of property to be developed.

3. Wildcat drilling, which is a well drilled in unproven territory to test the area for oil or gas (fig. 17).

4. Travel over existing roads, ORV use, construction of new access road, and/or the reconstruction of old roads and trails.

5. Campsite establishment and building construction (in remote areas).

Feasibility Studies/Operating Plan

If exploration work is successful, industry generally conducts a feasibility study to determine if economic conditions warrant development. A formal feasibility study includes an economic analysis of the rate of return that can be expected at a certain rate of production. If the results of the study are favorable, the operator may decide to proceed to the development phase. The operator initiates this phase by submitting an operating plan. Generally, the request (or operating plan) describes the operator's proposed mining methods, access routes, waste disposal plans, environmental protection measures, and reclamation program.

To evaluate the plan environmentally, the Forest Service requires baseline data. Although the Forest Service is responsible for collecting this information, it is often done by industry

Figure 17. Typical drill pads require 2-4 acres.

Figure 18. Pumps are installed during development.

through a cooperative agreement. Information gathered by the various disciplines includes:

1. The site's geologic characteristics.
2. The type of soil and vegetation present on the site prior to drilling.
3. Details of regional wildlife in the area.
4. Cultural resources.
5. Hydrologic factors (surface and subsurface).

Baseline data are used as a yardstick to measure environmental impacts and the success of reclamation.

Before industry can proceed with development, the operating plan must be approved by the authorized Government officials. If necessary, either industry or the Forest Service may submit amendments modifying the plan to satisfy regulatory requirements. Such amendments may also be made throughout the development and mining processes.

Development

After a decision is made to proceed with the project and the operating plans and leases are in place, development work begins. In oil and gas operations, development is defined as the work of preparing a reservoir for extraction and transportation. Industry activities might include:

1. Opening up the reservoir by development drilling, and installing the equipment needed for extraction (fig. 18).
2. Extensive drilling of the resource to determine its grade, volume. and boundaries.
3. Improvement or construction of roads, pipelines, utilities, and mud pits (fig. 19).
4. Preparatory work for processing.
5. Construction or arrangements for workforce housing.
6. Submission of amendments to the approved operating plan, if necessary.

Production can begin immediately following development; however, the company may choose to delay production. Reasons for such delay might include: (1) Additional property, water rights, surface rights, et al., may need to be acquired; (2) better market conditions may be anticipated; (3) equipment or personnel problems may arise; (4) contract problems may need to be worked out; (5) cash flow problems may exist; or (6) an assortment of unrelated problems might best be solved by simply delaying the project. Also, with leasables, another reason for delay is that pipelines or transport facilities may be lacking or a market has yet to be established.

Production/Abandonment

As production closes down on certain areas, they are reclaimed while other areas continue to produce. Therefore, because production and abandonment often occur simultaneously, they are discussed together here.

Production: Production is the process of extracting and transporting mineral products from the site to a processing location or to market.

Extraction of oil and gas involves:

1. Continued drilling and development of the field.
2. Installation of a pressure maintenance system.

Figure 19. Most roads (left) and improvements (right) are constructed during the development phase.

3. Establishing means for waste disposal.

4. Installation of a secondary and tertiary recovery system.

5. Installation of communication and production systems.

6. Building, or otherwise establishing, facilities for housing the workforce.

Abandonment: The abandonment phase of a leasable (oil and gas) project is generally comparable to the reclamation phase of a locatable or salable project. Industry activities during abandonment of individual wells may start early in a project and continue through the depletion of the field, with the bulk of activity occurring at the conclusion of the project. Industry activities during abandonment generally include:

1. Removal of equipment, buildings, and facilities.

2. Field cleanup.

3. Well abandonment and plugging.

4. Elimination of hazards.

5. Surface reclamation, including landscaping, reseeding, and other erosion control measures.

SALABLE MINERALS

Legal Basis

Mineral materials are disposed of from National Forest System lands under the authority of the Materials Act of 1947, as amended by the Act of 1950 and the Act of 1955. Called salables, these materials may be acquired only by purchase or free-use permit. Salable minerals (common varieties) are sand, stone, gravel, pumice, pumicite, cinders, and some clay.

All mineral material must be appraised and sold at not less than the appraised value, except material disposed of to Federal or State agencies, municipalities or nonprofit organizations. These agencies and organizations may receive the material without charge, provided the materials are not used for commercial purposes or resale and provided the site is reclaimed to productive use.

If the appraised value of the material exceeds $1,000, it must be sold to the highest bidder at public auction. Notice of sale must be published once each week for four consecutive weeks in a newspaper having general circulation in the county in which the material is located. The competitive sale may be by sealed bid or auction.

If the appraised value is $1,000 or less, the material may be sold to a qualified applicant by Special Use Permit; however, no more than $1,000 worth of materials may be sold to any one applicant in any one area in any one period of 12 consecutive months. (Above three paragraphs from "Handbook of Mineral Law," by Terry S. Maley, second edition, revised 1979.)

Although these materials are sold, the U.S. Government still has the right to use the surface and issue permits. Permits, leases, and contracts will require reclamation of disturbed land, as well as an adequate bond sufficient to insure reclamation.

Chapter 5

LINKING ACTIVITIES, IMPACTS, AND EFFECTS: A FRAMEWORK FOR ANALYSIS

This chapter presents an analytical framework for relating mineral activities to changes in the environment and to subsequent effects on wildlife and their habitat. It provides the biologist with a tool for systematically analyzing these effects.

Each phase of mineral activity has the potential for impacting[20] (changing) the environment, causing subsequent changes in the wildlife habitat and, in some cases, wildlife behavior and populations. The analysis (identification and quantification of the impacts and effects) and the evaluation (determining the significance of the effects) are somewhat complex tasks that require the biologist to take a disciplined and thorough approach to make the job as objective and professional as possible.

As a member of an ID team performing an assessment of a minerals project, the biologist provides information on the following items to the team:

1. Wildlife habitats and species present.
2. Wildlife habitat/species relationships.
3. Specific characteristics of the proposed activity that are pertinent to wildlife.
4. Consequences to wildlife from the changes resulting from the project, directly or indirectly.
5. Contributory effects on wildlife from natural processes, such as plant succession.
6. Cumulative effects on wildlife from all land-management activities in the project area, and effects that occur on the broader area for wide-ranging and/or migratory species.

In addition, the biologist presents alternative measures needed to provide for wildlife and habitat and to accomplish the objectives set forth in the forest plan. Along with this information, the biologist identifies wildlife trade-offs and makes recommendations to the land manager.

ACTIVITY/IMPACT/EFFECT RELATIONSHIPS

The effects of mineral activities on wildlife are determined by:

- The type of exploration and extraction processes.
- The characteristics of the site.
- The wildlife habitat and species present.

Each operation needs to be assessed on a site-specific basis, considering the activities and impacts expected by each phase of operation. In some cases, when multiple activities are occurring concurrently or in phases, the cumulative effects also need to be considered. Some points to keep in mind are:

1. Impacts can be a primary result of the mineral operation, such as loss of habitat, or the effect can be a secondary one, such as occurs when the human population of the surrounding area grows and hunting and fishing pressures increase.
2. Impacts and effects can be direct and affect the animal, such as an increase in road kills, or they can be indirect and affect habitat or some aspect of the total needs of the species.

[20] As used in this document, the term "impact" means change of an existing condition and has neither negative nor positive connotations.

3. The impacts can occur either onsite (fig. 20) or offsite (fig. 21). Ancillary facilities, such as pipelines and powerlines, are often involved in mineral activities.

4. The effects on wildlife that result from the changes can be considered positive for some wildlife species (new water resources for wildlife), negative for some species (harassment of wildlife during the mating season), or neutral for still other species (a slight alteration of a migration route).

5. The effects can be considered as site specific (for an individual project) or cumulative (for many projects in a given area).

6. Effects on habitat can be classed as those that affect the suitability of the habitat (food, cover, water) and those that affect the availability of the habitat (people/wildlife encounters, noise).

7. Effects on wildlife can influence behavior (change in pattern of use) or directly affect population levels.

8. Increased human presence can result in more people/wildlife encounters and higher noise levels that may affect the availability of the habitat. Increased population may also result in more accidental wildlife deaths and perhaps poaching that would directly affect the wildlife population.

Table 5 summarizes some of the effects on habitat and on animals that may occur as a result of mineral activities.

GENERAL CONSIDERATIONS

The biologist should keep in mind a number of general considerations when assessing the effects of mineral activities on wildlife. The following list of considerations is not all-inclusive. However, it does identify certain items to consider in the analysis.

1. Activities and impacts by phase of mineral operation. The effects of mineral operations on wildlife are determined by the type of exploration, the extraction process, the characteristics of the site, and the wildlife present. Therefore, each operation needs to be assessed on a site-specific basis. The biologist, working with the minerals specialist, identifies the activities in the various phases of the project and the impacts that are expected. The season of the year in which the activities are likely to occur should be noted, as the time of year is sometimes significant in determining wildlife effects. This description of activities and impacts, by phase of activity, provides the basis for considering the effects on various wildlife species. The tables at the end of this chapter provide examples of these descriptions.

Figure 20. Drilling activity can affect wildlife use patterns.

Figure 21. Offsite facilities, such as powerlines and pipelines, can affect wildlife and their habitat.

2. Different effects by species. The biologist must identify which species are expected to be positively affected, adversely affected, or not affected by the proposed activity. The duration of the effect should also be determined (see point 4).

3. Duration of effects. The effects of some mining projects are short-term or temporary, while others may have long-term or permanent consequences. Determination of the longevity of the expected effects helps the biologist recognize the significance of the activity to wildlife.

4. Scope of effects. Proposed activities differ in intensity of effects and extensiveness of the area affected. The intensity of the effect of a particular activity may differ, depending on the phase of activity. For example, in certain types of operations, people/wildlife encounters may be greater during development than exploration even though the area affected is more limited. Also, an intensive activity may not be important to a large variety of wildlife species if the habitat area impacted is small. It is also possible that an extensive activity may have minimal effects on wildlife, even if it occurs over a large area.

5. Season of activity. The season of the year in which the activities will occur should be considered. Activities that may have significant consequences to some wildlife during a particular season, such as spring calving season for elk, may have less consequences if conducted during another period of the year. Also, some activities may have negligible effects on resident species in the area but could affect migratory species that visit the area during a particular season.

6. Adaptability of wildlife species present in the area. The adaptability of species present is analyzed to determine their vulnerability to expected mining activities. For example, the analysis might consider the effects of increased noise levels and of habitat availability (fig. 22). This analysis could include an examination of the mobility of species present and opportunities for habitation in adjacent areas. The home range of the species involved usually will dictate the size of the study area required, but for

Table 5.—*Impact/effect relationship*

Result of mineral activities (impacts)	Effects on habitat	Effects on animals
A. Direct (animal)		
1. Changes in animal demand due to increased human population • Increased hunting and fishing • Accidental wildlife deaths • Poaching		Population • Direct mortality
B. Indirect (habitat)		
1. Changes in location, magnitude, frequency, and duration of human presence	Habitat availability • People/wildlife • Noise	Behavioral • Changes pattern of wildlife use Population • If habitat is essential, could affect population
2. Changes in: • Topography • Soils • Vegetation • Water supply • Water quality (surface) • Water quality (subsurface) • Air quality	Habitat suitability • Food • Cover • Water • Air	Behavioral • Changes pattern of wildlife use Population • If habitat is essential, could affect population

Figure 22. The adaptability of species is an important consideration.

Figure 23. Riparian areas support a diversity of fish and wildlife.

migratory and wild-ranging species, a broader land area must be considered.

7. Sensitivity of the area in relation to wildlife. Some areas may be extremely sensitive to alteration because they contain restricted habitats of specific wildlife species. (An example of a restricted habitat is a riparian zone in a predominantly arid region, as shown in figure 23.) Even low-intensity or small-acreage projects in areas of this type could result in significant consequences to some wildlife species. The requisites for wildlife, such as food, cover, water, reproduction, and migration routes, should be evaluated to identify the area's level of sensitivity. Also, the presence of federally classified species and their habitats should receive particular attention in the assessment.

8. Resiliency and tolerance of vegetation. If the vegetation is to be altered or exposed to stress, such as air pollution, the degree of various plant species' resiliency and tolerance to the

Figure 24. Mineral and energy developments can result in new towns.

Figure 25. Improved access for mineral activities can affect wildlife use patterns over a large area.

disturbance may need to be analyzed. In areas of high precipitation, for example, disturbed areas will normally be revegetated more readily than in arid regions. The type of vegetation and its ability to recover from disturbance are related to the duration of the effect.

9. Habitat diversity—minimum habitat requirements and viable populations of wildlife species. The quantity, quality, and distribution of habitat components required by the wildlife species in the area should be considered. The biologist must determine if the requisites necessary to maintain viable populations in the area will be present when the project is in operation and after it is completed. This analysis may require an examination of onsite and offsite areas influenced by the project.

10. Potential for the area's rehabilitation. The potential for habitat rehabilitation and/or opportunities for improvement should be determined for projects expected to impact wildlife habitat.

11. Contributory effects. Effects that occur naturally and have no relationship to the activity, such as plant succession, must be examined to determine the contributory effect on wildlife.

12. Consequences and risk associated with unplanned events. Certain projects may hold risks for wildlife because of unplanned but possible events, such as sedimentation or chemical pollution of streams. The likelihood of such events occurring and the consequences to wildlife should be considered.

13. Human population growth. Whether a project is expected to influence human population growth is an important component of the biologist's assessment. The level of human population affects the patterns of consumptive and nonconsumptive use of the wildlife resource, the degree of harassment, and secondary impacts such as changes in water quality and quantity (fig. 24).

14. Accessibility of the area. Increased accessibility to previously remote areas may significantly affect some wildlife species because of increased encounters with people (fig. 25). Therefore, the impact of increased people/wildlife encounters may need to be evaluated.

15. Cumulative effects. The effects of all other Forest activities and resource uses in relation to proposed mineral activities are an important part of the wildlife analysis. The cumulative effects of mineral projects that are sequential in nature—for example, oil and gas exploration leading to development that results in production—should be considered.

PERSPECTIVE

The following sample charts (tables 6-9) for oil and gas and hardrock operations show typical activities that occur by phase of operation and some general ratings as to the magnitude and duration of the impacts. Note that the ratings in tables 8 and 9 are general, and impacts for any given operation or site may differ greatly. The biologist working on a project may want to develop similar charts showing planned activities and expected impacts.

Table 6.—*Typical activities likely to occur at various phases of oil and gas development*

Activities	Phases				
	Preliminary investigation	Exploration (Primary/seismic)	Development (Including wildcat wells)	Production/ abandonment	Post-operation
Helicopter use	X	X	X		
Explosives	X	X	X		
Existing road use	X	X	X	X	X
Road construction	X	X	X		
Site construction			X	X	
Water			X	X	
Wastes			X	X	
Living quarters			X	X	
Field development					
Wells		X	X	X	
Pipelines			X	X	
Power lines				X	
Abandonment					
Wells and facilities			X		X
Transportation network					X

Table 7.—*Typical activities likely to occur at various phases of mining—hardrock minerals*

Activities	Phases				
	Prospecting	Exploration	Development	Production/ reclamation	Postmining
Helicopter use	X	X			
Explosives	X	X	X	X	
Existing road use	X	X	X	X	X
Road construction	X	X	X	X	
Site construction			X	X	
Water			X	X	
Wastes			X	X	
Living quarters			X	X	
Power lines			X	X	
Reclamation				X	X

Table 8.—*Magnitude and duration of selected impacts from mineral activity on wildlife—oil and gas*

Types of activities	Impacts					
	Human/ wildlife encounters	Noise level	Vegetation	Water	Soil	Air quality
Seismic exploration						
• Helicopter	M/ST	H/ST	L/ST	N	L/ST	L/ST
• Ground rigs (explosives)	M/ST	H/ST	L/ST	L/ST	L/ST	L/ST
• Ground rigs (drill)	M/ST	M/ST	L/ST	M/ST	L/ST	L/ST
Exploratory drilling						
• Road access	M/INT	M/ST,L/INT	M/ST,INT	M/ST,INT	M/ST,INT	L/INT
• Pad development	M/ST	M/ST	M/INT	L/ST	M/INT	L/INT
Water	L/ST	N	N	M/INT	N	N
Wastes	N	N	M/INT	M/INT	M/INT	L/INT
Living quarters	M/INT	L/INT	L/INT	M/INT	L/INT	L/INT
• Drilling and servicing	H/INT	M/INT	L/INT	M/INT	L/INT	M/INT
Field development						
• Roads	M/LT	M/INT	M/INT	M/INT	M/LT	M/INT
• Wells	M/INT	M/INT	M/INT	M/INT	M/INT	M/INT
• Pipelines and tanks	H/INT	L/INT	M/INT	M/INT	M/INT	L/INT
• Servicing	H/INT	M/INT	N	N	N	M/INT
Production						
• Roads	M/LT	N	M/LT	L/LT	L/LT	L/LT
• Pipelines and tanks	L/LT	N	L/LT	L/LT	L/LT	N
• Servicing	M/LT	L/LT	N	N	N	L/LT
Postmining	M/INT	L/ST	M/ST	N	M/ST	N

Impact Key: **Magnitude*** — N = None; L = Low; M = Moderate; H = High

Duration — ST = Short term (1 day to 1 month); INT = Intermediate (1 month to 2 years); LT = Long term (2 years to 40 years)

*Relative rankings for this commodity only. These ratings are relative in nature and ratings for any given activity or site may differ greatly.

Table 9.—*Magnitude and duration of selected impacts from mineral activity on wildlife—hardrock minerals, major, long term*

Types of activities	Impacts					
	Human/ wildlife encounters	Noise level	Vegetation	Water	Soil	Air quality
Access and transmission corridors						
• Access roads	M/LT	M/LT	M/LT	L/LT	L/LT	L/LT
• Haul roads	H/LT	M-H/LT	H/LT	M/LT	M/LT	M/LT
• Slurry lines	M-H/LT	L/LT	M/LT	L/LT	L/LT	N
• Conveyors	M-H/LT	L/LT	L/LT	L/LT	L/LT	L/LT
• Electric lines	L/LT	N	L/LT	N	L/LT	N
• Railroads	H/LT	H/LT	M/LT	L/LT	M/LT	M/LT
Mine development						
• Pit development	H/LT	M-H/LT	H/LT	M/LT	H/LT	M/LT
• High walls	H/LT	M-H/LT	H/LT	M/LT	H/LT	M/LT
• Waste dumps	M/LT	N	M/LT	M/LT	M/LT	L/LT
• Storage—ore and top soil	L/LT	N	M/LT	M/LT	M/LT	L/LT
Ancillary improvements						
• Office, warehouses	M/LT	M/LT	L/LT	L/LT	H/LT	L/LT
• Shops, storage	M/LT	M/LT	L/LT	M/LT	H/LT	M/LT
• Onsite living	M/LT	M/LT	M/LT	M/LT	H/LT	L/LT
• Mill site	H/LT	M/LT	M/LT	L/LT	M/LT	M-H/LT
• Tailing ponds	L/LT	N	L/LT	M/LT	L/LT	L/LT
Postmining	N	N	L/LT	L/LT	L/LT	N

Impact Key: **Magnitude*** — N = None; L = Low; M = Moderate; H = High

Duration -- ST = Short term (1 day to 1 month); INT = Intermediate (1 month to 2 years); LT = Long term (2 years to 40 years)

*Relative rankings for hardrocks only. These ratings are relative in nature and ratings for any given activity or site may differ greatly.

Chapter 6

POTENTIAL EFFECTS AND MITIGATIONS

If the analysis of a company's operating plan shows that mineral activity is expected to affect wildlife, the significance of these effects must be evaluated and management strategies must be developed to protect the resource. In this respect, the biologist performs two functions: (1) reviewing the company's operating plan to evaluate the adequacy of the proposed mitigation measures; and (2) if necessary, suggesting revisions to the plan and recommending appropriate mitigation measures. Although mitigation measures are identified in the operating plan before the mineral project begins, adjustments can be made to the plan during operations if necessary.

Throughout the evaluation phase, the biologist will be faced with questions involving the significance of the effects and appropriateness of mitigation measures. Some of these considerations are:

1. Legal implications. Expected effects on (1) Federally classified species and (2) water quality are two major areas of importance in terms of legal mandates for surface-resource management. The legal implications of mineral law and regulations are particularly important when apparent conflicts between wildlife mandates and the statutory rights of the miner must be resolved (see chapter 2).

2. Compatibility of the activities with formal wildlife allocations and management objectives in the project area. It is important to consider broad-level planning documents, such as the forest land-management plan and other comprehensive plans, when evaluating the expected effects on wildlife. Evaluations need to consider not only the expected changes to the "existing condition," but also how the project might affect the ability to accomplish the objectives in the forest plan.

3. Value and uniqueness of habitat present. The value and uniqueness of the habitat in an area is an important consideration. For example, limited wetland and riparian habitat in an arid region has a greater value to wildlife than similar habitats in regions with heavy rainfall. The presence of important transition areas between habitat types should also receive special emphasis in the evaluation, since the number of species present in transition areas is greater than in surrounding areas.

4. Economic, social, and cultural value of the species in the area. These value judgments involve an analysis of onsite consumptive and nonconsumptive use of wildlife in the area, and offsite use of migratory species.

5. Appropriateness of mitigation measures. To determine appropriate mitigation measures, the biologist evaluates:

- The degree to which the effect can be minimized.
- The availability and practicality of technology to implement the proposed mitigation measures.
- The expected success of each procedure in protecting or benefiting wildlife.
- The relative cost of achieving each level of protection—for example, the cost of the best protective measures versus the cost of achieving minimal acceptable standards.

Although mineral activity may present some opportunities for wildlife habitat improvement, the focus of this chapter is on lessening adverse effects. Chapter 7 focuses on opportunities for wildlife.

To provide the biologist with a process for evaluating and mitigating potential adverse effects, this chapter discusses the types of effects that may occur, and suggestions for minimizing the effects. It is not the intent of this guide to provide a detailed discussion of each type of effect nor to suggest that

"standard" mitigation measures exist for all projects. Effects and mitigation measures need to be considered on a case-by-case basis. The U.S. Fish and Wildlife Service (Office of Biological Services) publication entitled "An Environmental Guide to Western Mining, Part Two: Impacts, Mitigation, and Monitoring," was used as the major source document for information contained in this chapter (FWS/OBS - 78/04, December 1977). A more detailed discussion can be found in that publication.

Figure 26. Vehicle movement and human presence can affect the normal movement and distribution of some wildlife species.

HUMAN/WILDLIFE ENCOUNTERS

Encounters between people and wildlife may adversely affect some wildlife species. The effect may be in the form of harassment or direct mortality of wildlife.

1. Harassment:

Description

Harassment, as used here, is a disruption of animal behavior caused by the actual presence of people or factors associated with their presence, such as noise and ground shock (fig. 26). Harassment can prevent some wildlife from using otherwise suitable habitat. The consequences of harassment can be significant if animals are denied use of habitat essential to their survival, such as winter range for deer.

Potential terrestrial effects

Human presence may have disruptive effects on wildlife during the initial phase of a project. Mineral or wildlife survey work, biological sampling, and drill rig operations are the types of activities that may affect a relatively undisturbed environment. Interruption of big game migration routes is a problem by fenced railroads or highway rights-of-way if no safe passage is provided for the animals.

Installation of electrical transmission lines involves clearing and modifying vegetation during construction and maintenance activities. Maintenance of lines requires periodic human presence and equipment in areas that are normally undisturbed. Also, dissemination of information about presence of Federally classified species may ultimately result in their destruction through indiscriminate and thoughtless visitation and collection by the general public.

The significance of the disturbance will depend upon its degree and the sensitivity of the wildlife species present. In grassland areas, the sphere of disturbance may be larger than in forests where vegetation screens the activity from view and muffles the noise.

Highly mobile animals, such as birds, may react to the disturbance by simply leaving or avoiding the area. However, animals that emigrate to other areas may encounter increased competition for resources with resident animals and may not survive. Most of the smaller, less mobile animals may coexist with the disturbance, but high levels of noise and ground shock may cause small mammals, reptiles, and amphibians to develop abnormal behavior or hearing loss.

Potential aquatic effects

The mere presence of people in a mine area will not usually have as disturbing an effect on aquatic wildlife species as it does on terrestrial species. The adverse effects on aquatic wildlife resulting from an increase in numbers of people are more likely to be in the form of direct mortality (see section 2).

Figure 27. Powerline corridors and structures should be planned to minimize effects on wildlife and their habitat.

Considerations for lessening effects

Depending on the specific impacts expected at a project site, various methods can be used to reduce harassment of wildlife. Some suggestions are:

- Formal programs to increase employee awareness of local wildlife concerns.
- Restricted access to sensitive wildlife areas or closures, if needed.
- Seasonal restriction on human activity during critical periods of wildlife activity in sensitive areas.
- Planning road and utility construction to avoid fawning, nesting, breeding, or other sensitive wildlife areas (fig. 27).
- Avoiding the construction of haul and access roads in areas where raptors are known to nest.
- Screening sensitive wildlife areas from the mining activities through use of vegetation and topographic features.
- Designing and locating fences to provide passages for wildlife.
- Establishing minimum flight elevations for aircraft over sensitive wildlife areas, particularly during exploration or surveying activities.
- Equipping machinery and vehicles with the best available noise and gaseous emission suppression devices.

2. Direct Mortality:

Description

Another effect associated with human/wildlife encounters may be the direct mortality of wildlife. Direct wildlife mortality could result from vehicle-wildlife collisions (onsite and offsite) and from an increase in the harvesting of animals, legal and illegal. Vehicle/wildlife collisions, of course, may also result in human injury or fatalities.

Potential terrestrial effects

Of special concern because of their potential for damaging vehicles and injuring people involved in collisions are big game species such as elk, deer, moose, and pronghorn antelope. Construction of roads in the vicinity of migration corridors, daily movement routes, or riparian areas greatly increases the potential for wildlife-vehicle collisions. High population densities of wildlife (such as mule deer on winter range) in particular areas crossed by roads also increase the likelihood of collisions.

Electrical transmission lines may cause bird mortality through collisions with the lines and support structures, especially in areas where natural obstructions do not exist. In some instances, electrocution may also be a factor.

Potential aquatic effects

Direct mortality of fish during mining operations is primarily limited to stream crossing sites, areas of heavy construction immediately adjacent to or actually in stream channels, and dewatered channels caused by the rerouting of streams. Pressure on game fish populations can be expected to increase as a result of increased recreational fishing by the general public and the miners and their families. In small streams and reservoirs, some depletion of fish stock may take place.

Intensive biological sampling of limited fish habitats near potential mine sites could also deplete local populations. This problem is of special concern in areas where federally classified fish species reside.

Considerations for lessening effects

- Keep fences to a minimum on big game migration routes.
- Design and locate fences to accommodate

the natural movement of big game animals, unless specifically designed to prevent access by wildlife to hazardous areas.

- Plan road construction to minimize likelihood of vehicle/wildlife collisions.
- Where possible, minimize traffic during early morning and late evening hours, especially during critical migration periods.
- Use mass transit to carry employees to and from the mine site.
- Install road caution signs indicating wildlife crossing areas and establish appropriate speed limits.
- Properly design and locate power lines to reduce transmission line/bird collisions and electrocution. Consider underground placement of these lines in particularly sensitive areas.
- Request specific harvest regulations for fish and wildlife in the area. These regulations are set by the appropriate State authorities.
- Inform the workforce of applicable hunting, fishing, and trapping laws.

HABITAT DISTURBANCE

Habitat disturbance occurs when any part of the surface resource is altered during mining. Changes can occur in: (1) vegetation, (2) air quality, (3) water quantity and quality, (4) topography, and (5) soils.

1. Vegetation Loss or Alteration:

Description

Vegetation may be altered or destroyed by offsite activities, such as construction of roads and pipelines, and by onsite activities. Most changes in vegetation that affect wildlife result from completely removing vegetation and establishing new types of vegetation that may differ from original plant communities. However, partial modification of the vegetative species composition or density can also affect wildlife.

Potential terrestrial effects

Loss or alteration of vegetation can adversely affect wildlife through destruction of food sources and cover. Wildlife that are not mobile or those species that depend on specific vegetation in the area may perish.

The larger, more mobile birds and big-game animals may be displaced to areas adjacent to the disturbed sites. If those areas are already occupied, the animals will perish. No matter how effectively displaced animals are able to utilize adjacent areas, the overall potential wildlife productivity of the area will likely be reduced. The total time that the area will be unavailable for wildlife habitation should be considered when evaluating the adverse effects.

Potential aquatic effects

Adverse effects to fish are most likely to occur when riparian vegetation is destroyed or altered. The adverse effects result from increased water temperatures, loss of organic food sources from the riparian vegetation, and an increase in sedimentation because of streambank soil instability. Removal of vegetation other than riparian types may also cause an increase in sedimentation from overland mass soil movement or surface soil erosion.

Considerations for lessening effects

- Alter vegetation only on those lands that are necessary for mining, processing, and other related operations.
- Maintain features such as:

  1. Standing dead trees that serve as nesting or resting areas for any species;

  2. Unusually tall trees that could serve as raptor nesting or perching sites;

  3. Large fallen logs that provide shelter for various species; and

  4. Isolated stands of woody vegetation that occur in flat, open areas and provide cover for ungulates.

- Use brush blades rather than dirt blades to preserve natural grass and low brush cover in areas where clearing rather than excavating is necessary for operation.
- Maintain vegetation around bodies of water and along all perennial streams and waterways that will not be used in operating the mineral development.
- Exclude habitat of federally classified species from the area of activity. If exclusion is not needed, insure that necessary measures are employed to protect the species.
- Revegetation of disturbed lands should be accomplished as soon as possible after operations have ended, including abandoned roadbeds.
- Special grazing systems or temporary

fencing of seeded or planted areas may be required to allow plants to become established prior to livestock or wildlife grazing.

- After the initial phases of revegetation, combinations of plants that will ultimately develop into stable and acceptable communities are established. Species are identified and planted; followup planting may be required. If revegetation by native species is desired, leave seed-source trees in place, and plant less competitive seedlings. By controlling overplanting, and planting companion species, the site can be more quickly reclaimed.
- Coordination with the vegetation specialist and soils scientist should occur when reviewing the operating plan, to choose plant species that are suitable for mine sites and that will provide the resources needed by wildlife in the area.

Additional information on vegetation can be found in the "User Guide to Vegetation"—USDA Forest Service Gen. Tech. Rep. INT-64, Nov. 1979.

2. Air Quality:

Description

Airborne contaminants in the form of gaseous emissions are caused primarily by the operation of heavy equipment and vehicles in the vicinity of the project site. Fugitive dust—another type of airborne contaminant—is caused by wind erosion of ore bodies and overburden during surface-mining activities, and by heavy equipment and transport vehicles.

Potential terrestrial effects

Vehicle exhaust contains potentially harmful gases, such as sulfur dioxide, nitrous oxide, and carbon monoxide, as well as heavy trace metals, such as lead. Heavy surface-mining activity in protected forested valleys could result in larger concentrations of harmful emissions, although the effects would be limited to areas adjacent to the mine site and access roads. Also, increased levels of lead in vegetation and wildlife have been observed in areas near heavy vehicle traffic. Plants absorb lead that accumulates on foliar surfaces. Animals may inhale or ingest the lead, or absorb it through the skin.

Fugitive dust results from various mining activities, but is greatest during the development and production phases. Dust may increase exposure to a higher than naturally occurring level of trace-element metals in local vegetation and wildlife. Actual toxicity of trace elements depends on several environmental factors. These factors include climatic conditions (particularly wind patterns); physical and chemical properties of the soil (some elements, such as arsenic, are more mobile in basic soil); species composition (some species can accumulate high levels of certain trace elements but not others); and the nature of local food webs. In areas of continual exposure, animals may suffer from disorders of the mucous membrances and pulmonary complication. (See table 10 for a listing of those trace elements that could possibly affect wildlife.)

Table 10.—*Effects of trace elements on wildlife and vegetation*

Trace element	Effect on wildlife/vegetation
Antimony	Generally considered as moderately toxic to all organisms
Arsenic	Potentially very toxic to plants and animals; actual toxicity depends on the chemical form and mode of uptake
Beryllium	Very toxic to plants and animals
Boron	Moderately toxic to plants and animals
Cadmium	Very toxic to most organisms
Chromium	Moderately toxic to plants and animals
Cobalt	Moderately to severely toxic to plants and animals
Copper	Moderately toxic to organisms at high concentrations
Fluorine	Potentially very toxic to plants and animals, particularly in the gas hydrogen fluoride
Gallium	Low order of toxicity to most organisms under natural conditions
Lead	Moderately toxic to plants and animals, although no toxicity has been reported under natural conditions
Lithium	Moderately to severely toxic to plants and animals
Mercury	Certain chemical forms can be very toxic, especially to aquatic organisms
Nickel	Less toxic to animals than to vegetation
Selenium	Animals are more susceptible than plants
Thallium	Moderately toxic to most organisms
Tin	Very toxic to plants, especially green algae; moderately toxic to mammals
Vanadium	Moderately toxic to vegetation and relatively nontoxic to animals
Zinc	Moderately toxic to vegetation and relatively nontoxic to animals
Zirconium	Moderately toxic to vegetation and of low toxicity to animals

Potential aquatic effects

Aquatic resources will not be significantly affected by airborne pollutants unless a body of water is located near the mine site. Trace elements contained in dust can accumulate in aquatic habitats. Dust from coal, bentonite, copper, oil shale, and phosphate typically contain trace elements that are associated with runoff from mine sites. All of these elements, along with uranium, radium, and thorium, and their decay products, are potentially toxic to aquatic species.

Considerations for lessening effects

Air quality at the mine site should be monitored to insure that State and Federal air quality standards are met. Air quality protection measures might include:

- Water sprinkling and oiling roads and trails; paving roads located near sensitive wildlife areas (fig. 28);
- Equipping vehicles and heavy equipment with emission control devices;
- Covering conveyor belts, especially in critical wildlife areas;
- Covering areas prone to wind erosion with mulch, straw, or matting material to prevent dust pollution;
- Water sprinkling waste rock, dumps, and tailing disposal areas.

3. Water:

Description

Decreases in surface and ground water quantity may result from use of water for mine operations, ancillary facilities, mill operations, dust control, and human use. Withdrawal of water from, or disruption of, an aquifer may lower the water table and cause localized drying of seeps and springs used by wildlife for drinking water. Such a reduction in moisture may also cause changes in vegetation composition.

Water quality considerations revolve around the fact that wildlife habitat can be polluted by toxic wastes entering ground- or surface-water supplies. Various State and Federal water-quality laws set standards for concentrations of polluting substances that result from mining, and these regulations are to be consulted.

The following discussion provides some general considerations for water supply, groundwater quality, and surface water quality.

a. Water supply

Potential terrestrial effects

Changes in water supply may force wildlife dependent on marshes or riparian areas to range farther for water, and thus encounter increased competition from animals already using the other water sources. Such competition often results in degradation of habitat.

A loss or modification of a stream and its associated vegetation can eliminate or reduce not only the resident wildlife but also migratory wildlife from vast surrounding areas, even though this wildlife may rely on the stream for a relatively short period of time. Disruption of

Figure 28. Scheduled watering of road surfaces can effectively reduce dust and prevent negative effects on vegetation.

stream zone corridors used by wildlife for food, cover, or escape, can create barriers to normal movement and reduce overall carrying capacity of the habitat.

Potential aquatic effects

The importance of water quantity changes on aquatic resources cannot be overemphasized.

Effects on aquatic resources include:

1. Impoundment, diversion, and withdrawal change natural-flow regimes, which are often detrimental to fish.
2. Any consumptive use of water by mines can not only lower streamflows, but can also reduce water supplies for reservoirs, which are common in foothill valleys.
3. Streams that have been severely dewatered are more prone to freezing (winter) and oxygen depletion (summer) with drastic effects on fish populations.
4. The operation of dewatering wells reduces the flow of groundwater into the pits by locally depressing the water table. This water table depression could, in certain cases, reduce the flow of ground water to surface waters, thus reducing streamflows or lake levels.
5. Runoff rates as well as overall changes in water supply can be affected by mining activities, producing changes in seasonal instream flow characteristics for perennial and intermittent streams.

Considerations for lessening effects

- Exclude wetlands and riparian vegetation from mineral activities. Consider use of buffer zones.
- Use water from a spring only if the spring is able to sustain the use.
- Replace the water lost as a consequence of exploration or mining operations; this must be done by the operator.
- Plan construction of mine facilities in areas other than floodplains or stream drainages where there may be risk to human life, pollution, or destruction of the existing environment caused by flood damage.
- Assure that any water appropriated for mitigation does not result in a shortage in the area from which the water is taken.
- Give priority for protection of water sources to permanent ponds or streams, then to semipermanent, seasonal, and temporary water bodies.
- Where depletions of the water supply are noted, replenish the volume as needed.
- Consider the acquisition of water rights by the mining company, with subsequent donation of the rights to the respective fish and wildlife agency, so that the water can be used to maintain or increase stream flows to previous levels.

b. Ground water quality

Description

Degradation of the chemical quality of ground water results from the leaching of ions from soil material or because of leakage from waste-management facilities; these materials can percolate down to the water table. Contaminated ground water has a minor adverse effect on wildlife and vegetation except where the water is discharged at springs, seeps, or wells, or is pumped to the surface for such uses as irrigation. Also, in areas where the water table is shallow, uptake of contaminated ground water can occur through vegetation.

Potential terrestrial effects

Contamination of ground water results from accidental leaks and spills associated with the operation of vehicles and machines, and the storage of fuels, various liquids, industrial pesticides, and herbicides. Ground water contamination can also result from pipeline breakage, holding pond failure, and leaching of salts and trace elements from overburden, waste rock, and ore storage piles. Spills and leaks tend to result in more concentrated, but widely spaced, ground water contamination, while pipeline breakage or holding pond failures can contaminate larger areas.

If shallow, contaminated ground water is taken up by plants, the plants may die or suffer considerable damage, thereby becoming unsuitable for wildlife food.

Potential aquatic effects

Contaminated ground water affects aquatic biota only in areas where this water supplements surface water supplies. Thus, the same considerations discussed in the terrestrial paragraphs apply here.

c. Surface water quality

Description

Depending upon the level of contamination, the polluted water source will either be avoided by wildlife or ingested. Ingestion may cause sickness or death, or it may have no effect on wildlife. Four sources of contaminants associated with mining have the potential for reducing surface water quality.

1. Increased sediment loads.
2. Leaching of toxic compounds or elements from exposed ore, waste rock, and overburden.
3. Introduction of excess nutrients from blasting and fertilizers.
4. Introduction of pathogens from septic systems.

In the case of surface mining and surface water quality, the potential for contamination of water supplies as a result of surface mining is great because of the prevalence of surface water in most areas. The potential for offsite contamination is also accentuated in areas where steep slopes and moderate-to-heavy rainfall serve to increase runoff unless proper measures are taken. In semiarid basins where water supplies are limited, the chance of surface water contamination is less, but the impacts on wildlife could be more severe, since available water may be limited for wildlife.

Potential terrestrial effects

The severity of the impact of reduced water quality on wildlife depends on:

1. The level of water use prior to contamination.
2. The relative abundance of alternate, undisturbed water sources.
3. The importance of the wildlife species that use the water source. For example, an endangered shore bird would be more important than an abundant and widespread songbird species.
4. The degree of contamination.
5. The extent to which the contaminants are distributed through water system networks. These effects may also be compounded by accumulation of toxic substances in aquatic biota that serve as food for terrestrial animals.

Broadcast spraying of herbicides can result in water contamination, especially if applied during windy periods, or if the herbicide is highly volatile or applied in a very fine spray. Certain herbicide chemicals, if ingested in large amounts by wildlife species at a spill site, could cross placental barriers to unborn young and result in birth defects.

Sewage sludge spills may also contaminate surface water. Without proper treatment, the sludge may contain heavy metals and pathogens that are harmful to wildlife if they enter the water supply. However, if the material is treated to remove these harmful substances, the danger is significantly reduced.

Increased levels of siltation will probably have little direct effect on the wildlife drinking it. However, the indirect influence could be much greater, because siltation reduces aquatic plant growth and production of other organisms used by wildlife for food.

Potential aquatic effects

Mining can impact aquatic life by: (1) increasing the level of suspended solids (turbidity); (2) increasing stream sedimentation, which results from erosion; (3) adding toxic substances to the water; and (4) decreasing instream flows by diversion impoundment and withdrawal.

The effects can be listed as follows:

1. High levels of suspended solids in streams can increase ventilation rates and the resulting oxygen consumption can affect fish. In addition, high suspended-solid levels decrease light penetration and reduce primary food source production.
2. Silt deposits in streams prevent water flow through interstitial areas in redds used by trout to hold eggs, which may cause eggs to die from lack of oxygen.
3. Stream sedimentation deposited in reservoirs reduces the waterholding capacity of the reservoir, also reducing available fish habitat.
4. Inorganic nutrients (fertilizers) such as nitrogen and phosphorus, stimulate algal and fish production if present in the proper quantities and lead to blooms of undesirable plankton species. Fish kills result from oxygen depletion.
5. Herbicides used during revegetation efforts can also be toxic to aquatic biota if they enter surface waters. PCB (polychlorinated biphenyls) contamination is a potential problem at mines large enough to have electrical substations. Leakage from an electrical transformer is the most likely source from which PCB's enter aquatic habitats.

6. Acid drainage from large surface mines is not normally a problem in the West. Alkaline soils and rocks generally cause any mine drainage in this region to be neutral or slightly alkaline, although some acid drainages have been associated with copper mining. However, surface mining of coal, uranium, gypsum, bentonite, oil shale, phosphate, and copper produces some specific water quality problems that are unique to the particular mining and milling process.

Considerations for lessening effects

- Emphasize measures for avoiding accidental spills and leachate contamination, rather than measures to mitigate the effects of these problems after they occur.
- Contingency plans for handling accidental spills can specify:

1. Methods for locating the source of the discharge.
2. How the discharge will be stopped.
3. How the spill will be contained.
4. Responsibility for and techniques employed in repair, cleanup, and monitoring.

- Limit use of poisonous substances, including pesticides, herbicides, or fungicides, and use only after full evaluation of possible effects and obtaining of necessary approvals.
- Become familiar with the levels of pollutants allowed in the discharge from various types of surface mines. Guidelines have been published by the U.S. Environmental Protection Agency (40 CFR 434; 40 CFR 440; 40 CFR 436).
- Keep access routes and areas of use clean of all garbage and foreign debris, and dispose of debris and garbage in an acceptable manner.
- Dispose of all solid and liquid wastes containing potential contaminants or injurious material in a manner that will not harm surface or ground water. Isolate potentially toxic leachates of minerals, overburden, waste rock, and soil storage and disposal piles to prevent contamination of the soil and ground and surface waters. Point-source discharges from mine dewatering and mineral processing waste water are controlled directly by the Federal Government. The EPA manual, "Water Quality Guidance for Mine-Related Pollution Sources (New, Current and Abandon)" (WPD 7-77-01, U.S. EPA Office of Water Planning and Standards, Washington, D.C.), lists 17 "control" principles to use in the selection and design of site-specific

Figure 29. Landfills and spoil piles displace wildlife and change their use patterns. These effects can be mitigated with sound planning and reclamation techniques.

pollution preventive measures and control practices.

Additional information on water considerations can be found in the "User Guide to Hydrology"—USDA Forest Service Gen. Tech. Rep. INT-74, Nov. 1979.

4. Topography:

Description

Topography is usually modified during a variety of mineral activities. Area surface-mining operations often generate a more moderate overall topography to facilitate revegetation. Open-pit mines are likely to require overburden disposal areas in addition to the actual pit backfill area. Overburden may be placed in valleys or natural depressions in more rugged areas, or piled against small hills or ridges on flatter terrain in intermountain basins. Recently, mine plans have attempted to blend the final contours of the reclaimed areas into the surrounding landscape.

Changes in topography that result from surface mining, although generally localized, can have major effects on the wildlife that may use the area after mining ceases (fig. 29). Topography influences microclimate and microhabitat by governing the amount of solar radiation received, and the effects of wind and humidity on wildlife.

Potential terrestrial effects

Changes in the relative amount of north- and south-facing slopes due to changes in topography have various effects on wildlife, depending on site-specific considerations. South-facing slopes in winter-range areas are important as resting and feeding areas for mule deer and elk. Reptiles may also need the warmer southern exposure to sunlight at different times of the day to regulate their body temperatures.

Natural topographic features such as caves, rough breaks, cliff faces, hummocks and hills, and valleys and canyons are extremely important to various wildlife groups, particularly during inclement winter or spring weather. Changes in microhabitat affect the nesting success of raptors, such as the golden eagle and prairie falcon, which are often highly dependent on specific microhabitat conditions that afford shading and sunning of the nest site at specific times of day.

Figure 30. Landform modifications can significantly alter natural watersheds.

Potential aquatic effects

Large-scale surface-mining activities can modify watershed morphology, thus affecting drainage patterns and streamflow trends (fig. 30). This is of special concern where mining activities occur in small branch watersheds of principal drainages. Direct destruction of important fish spawning grounds can be considered the most significant impact resulting from removal of natural aquatic shelters.

Considerations for lessening effects

- Contour disturbed areas to provide favorable microclimatic conditions for selected wildlife species.
- Maintain topographic features important to wildlife, particularly in areas such as shrub steppe, grasslands, and wetland riparian areas, where such features are limited. In dry, open areas where distinct topographic features are less common, preservation of such features may be quite important to certain wildlife species.
- In cases where preservation of onsite features is not possible, refinement of adjacent areas should be considered. These measures are discussed in chapter 7 in terms of opportunities for the wildlife resource.

Additional information on topography can be found in "Creating Land for Tomorrow," Landscape Architecture Technical Information Series, Vol. I, No. 3, Oct. 1978.

5. Soils:

Description

Changes in soil materials generally have an indirect impact on wildlife resources, except when ground dwellers' habitats are destroyed. Changes in soil properties may result from handling of soils. Major considerations for wildlife include the suitability of the soils for site revegetation and prevention of soil movement into aquatic habitats (fig. 31 and 32). Also, space requirements for soil storage may eliminate certain wildlife habitat.

Potential terrestrial effects

Soil saved for reapplication has an indirect impact on wildlife, because if insufficient soil is saved, the prospects for successful revegetation are decreased. The greatest amount of waste material is produced by (1) open pit operations that require the removal of thick overburden, and (2) local processing of low-grade ore. Both types of operations require large land areas for waste storage.

Changes in chemical properties of soils occurring during soil handling operations may have positive, negative, or indirect impacts on wildlife through changes in nutrient levels, pH, salinity, trace-element concentrations, and the chemical constituents of the soil solution.

Compaction of soils may occur during soil handling operations. Compaction of surface soils can decrease infiltration and increase runoff, possibly leading to a reduction in vegetation cover and an increase in sedimentation in streams. Compaction can also lead to poor soil structure. The rate of seedling emergence or the rate of root elongation can be decreased in compacted soils. Root penetration into soils can also be restricted if compacted layers are present. A compacted lower soil layer might also decrease leaching and cause retention of soil moisture in upper soil layers. If upper soil layers contain toxic chemical elements or compounds, revegetation potential may be decreased, or a biomagnification of elements harmful to wildlife may result.

Potential aquatic effects

Sodium and other salts are commonly leached from disturbed surfaces during runoff, increasing the total dissolved solids content of ground water and, ultimately, downstream waters.

Dissolved solid levels that form solutions with osmotic pressure equal to or greater than fish blood are usually harmful to freshwater fish although some species can withstand higher levels. These materials, however, help reduce the toxicity of heavy metals, such as copper and zinc.

Considerations for lessening effects

Although the primary responsibility for soil conservation rests with the soils scientist, the biologist works with the ID team to make sure wildlife values are considered in the planning process. The soil plan must be devised on a site-specific basis so that the reclaimed area can support the vegetation needed by the wildlife resource. Some considerations are:

- Remove and stockpile topsoil prior to removing overburden. Locate stockpiles where

Figures 31 and 32. Soil erosion can be minimized through timely rehabilitation of the disturbed site.

they will not be covered by spoil materials. Stockpiled topsoil can be used as a surfacing material for areas where revegetation for wildlife is proposed in the reclamation plan.

- Avoid placing waste dumps in areas where topography or vegetation provide necessary habitat for the survival of resident wildlife species. During reclamation of waste dumps, provisions should be made for: proper regrading of topography; revegetating with plant species suitable to wildlife needs; and supplying offsite habitat during reclamation.

Additional information on soils can be found in the "User Guide to Soils"—USDA Forest Service Gen. Tech. Rep. INT-68, Nov. 1979.

To summarize this chapter, tables 11, 12, and 13 show the progression of mining activities leading to impacts, which ultimately affect wildlife. Table 11 shows the intensity of impacts from various activities in relation to the type of mine; table 12 relates mining activities to their expected results; table 13 shows the intensity with which the changes caused by mining are expected to affect various wildlife species.

Table 11.—*Relative intensity of impacts from various mining activities, by mine type*

Mining activity	Type of mine									
	Coal area surface	Coal underground	Coal contour surface	Uranium solution	Uranium small surface	Uranium large surface	Copper	Oil shale surface	Bentonite and gypsum	Phosphate
Exploration	2	2	3	2	2	2	2	2	2	2
Surface clearing	1	3	2	3	2	1	1	1	2	1
Construction of facilities	2	2	3	3	3	2	2	2	3	3
Excavation	1	3	2	—	3	1	1	1	2	1
Mineral removal	3	—	2	2	3	2	2	2	2	2
Mineral storage	2	2	3	3	3	2	2	2	3	2
Mineral transport	1	2	3	3	3	3	2	2	3	2
Operation of support facilities	2	2	2	2	3	1	2	1	2	2
Waste materials containment and disposal (including sediment)	2	2	2	3	3	1	1	1	3	2
Personnel transport	2	2	2	3	3	1	1	1	3	2
Work force	1	1	2	3	3	1	1	1	3	2
Reclamation	1	3	2	3	3	2	1	1	1	1

Intensity:*

1 = major, 2 = moderate, 3 = slight, — = unanticipated or insignificant.

*These numerical ratings are general in nature and the ratings for any given site or operation may differ greatly.

Table 12.—*Relative intensity of impacts resulting from various mining activities*

Result of mining activities (impacts)	Mining activities											
	Exploration	Surface clearing	Construction of facilities	Excavation	Mineral removal	Mineral storage	Mineral transport	Operation support	Waste material	Personnel transport	Associated populations	Reclamation
Human/wildlife encounters												
Harassment	3	3	1	—	2	—	3	1-2	—	2	1	2
Direct mortality												
Aquatic wildlife	3	1	2	2	—	—	2	3	1	3	2	3
Terrestrial wildlife	—	2	3	—	—	—	2	3	2-3	1-2	1	—
Habitat disturbances												
Changes in vegetation	—	1	2	—	—	—	—	3	3	—	—	1
Changes in water supply/streamflow	3	2	3	3	—	—	—	2-3	—	—	2	2
Changes in surface water quality	3	2	3	—	—	3	3	2-3	1-2	—	—	3
Changes in ground water quality	3	—	—	3	2	—	—	3	2	—	—	—
Changes in soils	—	1	2	—	—	—	—	3	3	—	—	1
Changes in topography	—	1	—	1	2	—	—	—	2	—	—	1
Generation of air-borne materials	3	1	3	2	3	2	2-3	3	2-3	—	3	3

Intensity:*

1 = major, 2 = moderate, 3 = slight, — = unanticipated or insignificant.

*These numerical ratings are general in nature and the ratings for any given site or operation may differ greatly.

Table 13.—*Relative magnitude of effects of various mining impacts on wildlife and habitat*

Result of mining activities (impacts)	Affected wildlife and habitat									
	Threatened and endangered (when present)	Migratory waterfowl	Raptors	Other birds	Ungulates	Furbearers	Small mammals	Fish/macro-invertebrates	Terrestrial vegetation	Aquatic riparian vegetation
Human/wildlife encounters										
Harassment	1	3	1	3	2	2	2	1	2	3
Direct mortality										
Aquatic wildlife	1	—	—	—	—	—	—	1	2	1
Terrestrial wildlife	1	—	2	—	1	2	3	—	2	—
Habitat disturbances										
Changes in vegetation	1	—	2	2	1	2	2	1	—	1
Changes in water supply/ streamflow	1	2	—	3	2	3	—	2	—	2
Changes in surface water quality	2	1	3	2	1	2	3	1	3	3
Changes in ground water quality	—	—	—	3	2	2	—	3	—	3
Changes in soils	—	—	—	—	—	—	3	2	1	2
Changes in topography	1	—	2	3	1	3	3	—	2	1
Generation of airborne materials	3	—	3	3	3	3	3	3	3	3

Intensity:*

1 = major, 2 = moderate, 3 = slight, — = unanticipated or insignificant.

*These numerical ratings are general in nature and the ratings for any given site or operation may differ greatly.

Chapter 7

OPPORTUNITIES FOR WILDLIFE

The Forest Service, as a public land-management agency, is charged with the responsibility of insuring that reasonable steps are taken to protect surface resources during mining and to compensate for the unavoidable adverse effects that may occur. At the same time, the Forest Service ID team, including the biologist, looks for opportunities that mining might present for wildlife. As applied here, an opportunity is a favorable condition in which to develop or enhance a resource—specifically, wildlife.

This chapter discusses some wildlife management opportunities that can arise from mineral activities. First, however, the biologist must remain aware of several "givens":

1. Mineral deposits occur only in specific locations. Although it is possible to negotiate a minor relocation of exploration activities, relocation of most activities is not possible once a deposit has been found.
2. The miner normally has certain rights that must be respected, depending on the mineral and its location.
3. The duration of some mining projects is long term, possibly continuing for several decades.
4. Substantial acreage can be involved in mineral projects.
5. Mineral projects usually involve numerous jurisdictions, which makes objective-setting and coordination more complex.
6. Mineral activities are phased and the multiple activities associated with mining can lead to multiple effects on the environment.
7. Lead time for responding to a proposed mineral project may be limited.

Because of these factors, the biologist has traditionally seen mineral development as inevitable, leading to adverse impacts that must be mitigated. While these factors cannot be ignored, mitigating actions are only one response. The biologist also may identify special opportunities for managing wildlife that arise during mineral activities. The opportunities may arise as a result of:

- Forest plan direction.
- Financing alternatives.
- New information to assist in managing wildlife, such as that available through surveys, research, or computer tools.
- Interagency coordination.
- Site-specific occurrences.

THE FOREST PLAN: A PERSPECTIVE FOR IDENTIFYING OPPORTUNITIES

The forest plan helps the biologist recognize opportunities for managing wildlife when a mineral project is proposed. It provides a broader view of wildlife goals than might be the case if the biologist analyzed the project only in relation to its effect on that one specific site. The results of a site-specific analysis are likely to show that the mineral project will adversely affect wildlife because it will change *existing* conditions on the site. The tendency may be to judge the mineral activity as undesirable because it will change the status quo. If the project is viewed in a larger context—a context provided by the forest plan—the biologist may determine that wildlife goals for the forest or region as a whole are attainable. Furthermore, ways in which the mining project presents opportunities for managing or enhancing wildlife may be identified.

As an example: Assume one wildlife objective stated in the forest plan is to increase game fish species to allow for more recreational angling. A second objective is to maintain the deer population. The area to be mined presently has no aquatic habitat but is a deer habitat. However, it is expected that mining operations will result in a large open pit and that in the process of extracting the mineral, an aquifer will be tapped, eventually filling the pit with water.

The biologist knows that if no mitigation measures are taken, this situation will result in a loss of deer habitat. However, the forest plan may reveal that the forest or region as a whole can satisfy the deer habitat objectives without this particular habitat. In this case, the biologist can look beyond the loss of deer habitat to an opportunity for creating additional fish habitat—thus meeting a second wildlife objective. What might have been seen as only an adverse effect to the deer population can now—based on the broader perspective provided by the forest plan—be viewed as an opportunity for increasing the potential to provide aquatic habitat to produce fish.

FINANCING ALTERNATIVES

In addition to monies provided through the Forest Service budget, opportunities may exist to obtain funds from other sources. For example, financing can sometimes be obtained from industry, local communities, or sportsmen's groups. These arrangements require close cooperation and advance planning between the Forest Service and the organization offering the financial assistance.

- *Private industry.* The feasibility of achieving wildlife objectives that go beyond the minimum required mitigation measures depends, partially, on the willingness of the mining company to provide financing for the work. The final plans for both financing and the construction of improvements will ultimately be determined by the mining company and the Forest Service land manager. Therefore, the biologist should provide information on opportunities for wildlife management to the land manager as early as possible in the planning process. This information should suggest a range of management opportunities and then relate each alternative to the costs and benefits expected. The land manager and industry can then negotiate reasonable requirements for specific projects.
- *Local community.* The local community may have considerable interest in a large mineral project because of its wide-reaching effects, such as population growth and land-use changes. Therefore, city, county, and State representatives, as well as private individuals, may become involved in providing additional financing for wildlife management opportunities if they can be shown esthetic and economic benefits that could be realized from integrating wildlife objectives into the planning of the project.

For instance, a community may have an economy that is partly based on tourism, in particular, recreational hunting and fishing. If additional tax revenue is expected from mining or mine-related industries, the local officials may wish to channel some of these funds to wildlife improvement projects in order to maintain the segment of the economy that relies on hunting and fishing activities. Or, the community may want to improve the

Figure 33. Research sample plots help to identify prescriptions that are successful for revegetating most areas.

Figure 34. Joint efforts by industry and Federal and State agencies can build wildlife measures into mine plans.

area's wildlife habitats for sightseers who will spend money in support industries such as hotels and restaurants.

When such an opportunity exists, the biologist coordinates information through the appropriate State agency and the community. In this way, funding for wildlife management opportunities may become possible through local fiscal planning.

INFORMATION OPPORTUNITIES

Throughout initial planning and all phases of the mining project, various types of information are available to the biologist for exploring management alternatives.

By consulting research publications, the biologist can take advantage of information already available. This can save time and money. Also, available research may suggest opportunities for managing the wildlife that can be used in conjunction with the mitigating procedures already identified in research literature (fig. 33).

Where existing information is inadequate, the minerals project may provide an opportunity to gather new information through monitoring, administrative studies, or research. The biologist may explore cooperative funding for such efforts with other Federal or State agencies and industry.

INTERAGENCY COORDINATION

Because wildlife habitats often span areas administered by more than one State or Federal land-management agency, cooperative efforts among the involved agencies may provide opportunities for wildlife management (fig. 34). For example, if an objective outlined in the forest plan is to increase the elk population by improving habitat, and the elk's home range falls within the administrative boundaries of several agencies, coordinated planning among the agencies would allow habitat improvement to take place over the entire home range, thus benefiting the elk. Furthermore, this wide-ranging effort could diminish the effect of the mining project on a particular elk habitat.

These cooperative efforts begin by identifying common goals and objectives for wildlife management. Once the goals are agreed upon, the involved agencies begin planning to achieve them. During planning, agreements must be reached on: data base; estimates of habitat potential to produce wildlife objectives; judgments of expected effects from mineral activities; and efforts to deal with those effects. The agreed-upon management procedures are then collectively implemented.

Although interagency coordination can produce opportunities for wildlife, it takes careful planning and communication. Traditionally, land-management agencies have confined their efforts to areas within their administrative boundaries. Because these boundaries do not usually correspond to ecological boundaries, this practice, at times, has complicated efforts to develop common goals and objectives for broader areas of land. In addition, the distinct charters of various Federal and State wildlife agencies can make coordination complex. However, every effort should be made to coordinate objective-setting and planning with other agencies, because cooperative efforts can allow the biologist to manage the wildlife in ways that would be impossible if work were confined to National Forest System land or limited to Forest Service authorities.

SITE-SPECIFIC OPPORTUNITIES

Mining-related opportunities may exist for both terrestrial and aquatic habitat improvement. The degree of improvement is based on what is reasonable—legally, technically, and economically. The best results can be obtained by working closely with the mine operator, the local community, and the other members of the ID team. The remainder of this chapter presents some examples of opportunities for managing wildlife that may occur during mineral activities.

Surface-use changes caused by mining can result in either impacts or opportunities, or they may have no effect on wildlife. In some cases, vegetation, water supply, topography, and uses of the land can be altered to enhance habitat and benefit the wildlife resource.

Vegetation. Some wildlife species could benefit from changes in vegetation if preferred

Figure 35. Wildlife browse species are propagated in greenhouses for field planting on reclaimed sites.

Figure 36. Perch structures can be artificially placed to benefit raptors.

vegetation that was previously in short supply is increased. Also, disturbance of a site generally results in a change in the successional stage of the vegetation community. This occurs when vegetation, removed from a site during mine development, is replaced by vegetation of an earlier successional stage. This successional process can be somewhat altered by artificial plantings (fig. 35). Because the various stages of succession are used by different communities of wildlife species, certain species will benefit from the change. At times, the mining development may result in more diversity of vegetation and support more species than did the original habitat conditions. In effect, the reclamation effort can be used to create or improve habitat for selected wildlife species. Often, it is impossible to protect the vegetation on a mine site during mining activity. In such cases, the potential to improve offsite habitat to support wildlife should be considered.

The principal objective of improving habitat is to increase the quality and quantity of food, water, and cover on adjacent sites, thereby increasing wildlife habitat diversity and productivity on those sites. This procedure helps to compensate for habitat loss in the mine area.

Improvement procedures for undisturbed sites should stress the increase in the quality and quantity of food, water, and cover. Some specific methods are:

- Selective thinning of dense vegetative stands and the planting of browse and forage plant species;
- Regulation of livestock use to decrease competition with wildlife;
- Replacement of brush piles and large rocks removed from the mine site in adjacent areas;
- Placement of nest boxes and perch structures where needed (fig. 36).
- Placement of nesting structures and roosts in wet areas to increase waterfowl use.

Water supply. Mining activities have the potential for increasing surface water quantities through surface discharge of water previously trapped in aquifers. Keep in mind, however, that aquifer pumping is likely to reduce the surface discharge of the aquifers in other areas. If the discharged water is of suitable quality and reasonably constant supplies can be maintained, the additional supplies could be beneficial to wildlife.

Drill holes are often used in mineral exploration. In instances where fresh water is encountered, opportunities may exist to develop these water sources for wildlife. Similarly, wells drilled for potable water may be converted for wildlife use following the abandonment of mining operations. Creation of pond or lake habitats could have positive effects on wildlife, but unless the new habitat is permanent—that is, the water supply is maintained by precipitation or runoff—long-term benefits will not be realized (fig. 37).

In areas where precipitation exceeds evaporation, there is a better possibility of creating permanent aquatic habitats than in arid regions. When new wet areas such as ponds, lakes, or streams are planned, the following should be considered:

- Locate wet areas away from the influence (including noise and human activities) of the mining site but close enough to serve displaced wildlife populations.
- Locate wet areas so that natural topographic or vegetative features offer protection, particularly in the form of windbreaks or shading. Such natural features not only protect wildlife but also reduce the evaporative effects of wind and direct sunlight.
- Contour shorelines so they are easily accessible to wildlife.
- Situate wet areas where soil characteristics are conducive to maintaining bodies of standing water for long periods of time.
- Introduce native riparian vegetation species if necessary. In cases where marshes or ponds are created, aquatic vegetation attractive to migratory waterfowl can be introduced.
- Maintain water levels so that minimum fluctuations occur. If water level fluctuations are substantial, it is often impossible to establish permanent vegetation along the shoreline or to avoid winterkill of fish.
- Manage the entire wet area to produce maximum water retention and minimum siltation of the wet area. This requires permanent, deep-rooted vegetation to assure soil stability.

Water quality. Normally, prescriptions dealing with water quality are designed to prevent degradation of water that passes through the mine site.

Opportunities for improving water quality, on the other hand, must be arranged for in the operating plan and entail the improvement of certain specific water quality parameters in water that passes through the mine site. An example would be to reduce the load of suspended and dissolved solids in a stream below premining levels. For such measures to be effec-

Figure 37. The creation of aquatic habitat can enhance the diversity of wildlife species.

Figure 38. Placer mining can destroy stream channels and create severe sedimentation.

tive in improving aquatic habitat, parameters specified to be improved must be the ones that are already degraded.

Aquatic habitat. When streams are rerouted, the new channel may be constructed to provide better habitat than the old channel (fig. 38). To insure this, the new stream channel should contain a diverse mixture of pools, riffles, and boulder obstructions; stable banks; and a varied bottom substrate of gravel and rubble. In areas where riparian vegetation is important for maintaining cool water temperatures by shading and for increasing nutrient levels in the stream, trees can be transplanted to the new stream bank. In areas where premining alterations of the stream channel have produced poor fish habitat, a carefully constructed new section of stream channel may provide better habitat than the old channel (fig. 39 and 40). The prevention of sedimentation and silt problems is an important consideration when constructing new streams.

In some instances, ponds and lakes can be constructed off the mining site to replace those eliminated by mining. In order to provide quality fish habitat, such ponds and lakes should have sufficient water depth to prevent winterkill, properly designed spillways to handle periods of high runoff, a high-quality water supply, and areas suitable for fish spawning. In some cases, trees may be necessary to shade the water and reduce wind velocity and subsequent evaporation rates.

When stream habitat improvements are planned, cooperation between Federal and State biologists and the mining company is essential to insure that improvement objectives adequately consider the affected wildlife species and their habitat requirements, such as food, cover, and water needs.

Stream habitat improvements can also be classified as direct or indirect. Direct measures are those that improve the aquatic-riparian stream areas, while indirect measures are those that improve streams through improvements to the watershed and/or floodplain within a drainage area. Stream habitat objectives can be developed to increase habitat or fisheries resources.

Stream habitat factors that can be improved include:

- Water quality (physical, biological, chemical, radiological);
- Instream flows;
- Streambed materials (spawning gravel);
- Stream channel structure (hydrology).

Fisheries features include:

- Species composition (numbers, biomass diversity);
- Type of fishery (nongame, game, threatened, endangered, sensitive, native, nonnative);
- Use of fishery regulations (protected, limited, or unlimited harvest).

After the type of improvement has been identified, various methods may be used for implementation. A listing of onsite and offsite procedures follows.

Figures 39 and 40. Gabion or structures can improve fish habitats.

1. Onsite

—Streamside and/or riparian area fencing or barrier placement.

—Stream bank log cribs; bank deflectors; bank matting and mulching.

—Check dams, logs, rocks, trash catchers.

—Current deflectors.

—Fish barrier dams.

—Fishways or ladders.

—Silt check dams.

—Streambed materials.

—Spawning channels.

—Fish screening.

—Culvert and bridge design.

—Design and placement of new stream channel.

—Streamside vegetation treatments and plantings.

—Stream bank brush shelters.

—Instream flows and water rights acquisition (stream levels; nutrient control; pH control; species stocking or eradication; buffer zone maintenance).

2. Offsite

—Land acquisition/withdrawal for resource protection.

—Floodplain zoning and riparian-area value identification.

—Water rights acquisition.

—Watershed and revegetation measures.

—Mine pond location and spill contingency plan.

—Other resource use coordination.

—Fish hatcheries.

—Spring source protection.

—Early input, planning, and design into mining and forest plan.

Topography. Opportunities to improve topography may be present either offsite or onsite during mine planning and reclamation (fig. 41 and 42). Features most important to wildlife should receive priority in these operations (fig. 43 and 44).

Where the reclamation of surface-mined areas involves re-creating terrain, the biologist has an opportunity to design specific features for selected wildlife species. This would include specifying landform characteristics, such as slope, aspect, type and juxtaposition of vegetation, and water bodies.

When planning for reshaping terrain, consider:

- Providing suitable slopes for good vegetative reclamation;
- Insuring that wildlife have access to watering areas and to summer and winter range;
- Providing areas with maximum southerly exposure when the objective is to create or improve winter range conditions;
- Leaving highwalls (unexcavated faces of exposed overburden) to provide desired wildlife habitat, particularly for raptors.

Computer-assisted planning tools allow the biologist to explore opportunities for wildlife management quickly and easily. Such tools can graphically display several alternative land-

Figures 41 and 42. Shaping and revegation of mine spoils can enhance aesthetics and provide wildlife forage.

Figures 43 and 44. Gravel mining operations that disrupt surface water conditions can be rehabilitated to provide an increase in wetland habitats.

forms and allow the land manager, in cooperation with industry, to choose the alternative that best achieves their mutual objectives. Thus, alternatives can be explored and evaluated prior to surface-disturbing activity.

Several methods have been developed for processing surface and subsurface data in digital form that a computer can quickly manipulate and display. By using topographic, surface, and subsurface data, the computer can depict what a proposed mining development will look like before any actual work begins on the site.

Soils. Soil improvement indirectly benefits wildlife by allowing better revegetation of a mine site. A soils scientist should be consulted during the planning process to identify opportunities for soil improvement.

If sufficient soils are saved, properly replaced, and compacted, revegetation prospects are improved because a good growth medium for plants is provided. Soils that are susceptible to erosion may need to be stabilized to ensure successful revegetation, and prevent sediment increases in aquatic habitats.

APPENDIX A

GLOSSARY

Acquired lands: Lands obtained by the Government through various exchanges, purchase, or gifts.

Alternative: The different means by which objectives or goals can be attained. Alternatives need not be obvious substitutes for one another or perform the same specific function.

Anadromous fish: Those species of fish which mature in the sea and migrate into streams to spawn. Salmon, steelhead, and shad are examples.

Aquifer: A geologic formation or structure that transmits water. Aquifers are usually saturated sands, gravel, fractured rock, or cavernous rock.

Baseline data: Data gathered prior to mining for the purpose of outlining conditions existing on the undisturbed site. Reclamation success is measured against baseline data.

Biologist: For purposes of this guide, the term includes biologists involved in all areas of the discipline.

Biota: The plants and animals of an area taken collectively.

Carrying capacity: The number of animals of a given species that a habitat supports, measured at the low stage of any animal population cycle.

Claim: The portion of mining ground held under Federal and State laws by one claimant or association by virtue of one location and record.

Common variety minerals: Minerals classified as such by statute primarily because of their widespread occurrence; they are disposed of by the Government as salables. Examples are gravel, stone, sand, and pumice.

Development: The work of preparing a proven ore body or reservoir for extraction and transporting.

Dissolved solids: The total amount of dissolved material, organic and inorganic, contained in water.

Economic feasibility: The degree of certainty or probability that a mineral commodity will be developed; factors considered are the type of mining activity and its cost in terms of time and money.

Environmental Assessment (EA): An analysis of all actions and their predictable short- and long-term environmental effects, which include physical, biological, economic, and social factors and their interactions. Also, a concise public document required by the regulations for implementing the procedural requirements of the National Environmental Policy Act of 1969 (NEPA).

Environmental Impact Statement (EIS): A document prepared by a Federal agency in which anticipated environmental effects of a planned course of action or development are evaluated, as described by the National Environmental Policy Act of 1969 (NEPA).

Erosion: The group of physical and chemical processes whereby earth or rock material is worn away, loosened, or dissolved and removed from any part of the earth's surface.

Exploration: The process of identifying and investigating mineral prospects in order to discover if a viable mineral deposit or reservoir exists.

Feasibility study: As applied to mineral activity, the feasibility study follows discovery of the mineral and is done by the operator. Its purpose is to analyze the rate of return that can be expected from the mineral development at a certain rate of production. Based on this study, the decision to develop an ore body or reservoir may be made.

Forest plan: See land-management plan.

Ground water: Water within the earth that is in the zone of saturation, where all openings in soils and rocks are filled—the upper surface of which forms the water table; water that supplies wells and springs.

Habitat: The location where an organism is generally found and where all essentials for its development and existence are present.

Interdisciplinary team (ID team): As proposed by recent Forest Service regulations, the interdisciplinary team will be comprised of Forest Service personnel who collectively represent two or more areas of specialized technical knowledge about natural resources management applicable to the area being planned. The team will consider problems collectively, rather than separate concerns along disciplinary lines. This interaction will insure systematic, integrated considerations of physical, biological, economic, and other sciences.

Land-management plan: A long-range land and resource management plan for one of the designated forest planning areas as specified in the National Forest Management Act of 1976 (NFMA), Section 6 Regulations; it outlines the most desired and alternative land uses for that site.

Land manager: A general term used to apply to the responsible official on a land unit; this could be the District Ranger, Forest Supervisor, or Regional Forester.

Leasables: Those minerals excluded from the 1872 Mining Law; they are developed under a leasing system.

Locatables: Those minerals located on public domain lands and subject to the 1872 Mining Law, as amended; such as gold, silver, and zinc.

Lode: A mineral deposit in consolidated rock, as opposed to placer deposits.

Management concern: An issue or problem requiring resolution, or a condition constraining management practices, identified by the interdisciplinary team.

Management indicator species: According to NFMA regulations, management indicator species are species identified for land-management planning purposes that include: (1) threatened and endangered plant and animal species in the area; (2) species with special habitat needs that may be influenced significantly by planned management programs; (3) species commonly hunted, fished, or trapped; and (4) species whose population changes are believed to indicate effects of management activities on other species found in the area.

Microclimate: The local climate of a given area usually characterized by considerable uniformity of climate over the site involved; the fine climatic structure of air space, which extends from the very surface of the earth to a height where the effects of the immediate character of the surface no longer can be distinguished from the general climate.

Mineral developments: This term is used in a broad sense and includes energy-related developments for such commodities as oil and gas, coal, and uranium, as well as commodities such as gold, silver, and molybdenum.

Mineral law: The collection of all laws affecting minerals and their development.

Mineral project: Specific mineral developments.

Minerals: This term is used in a broad sense and includes all substances occurring naturally with characteristics and economic uses that bring it under the jurisdiction of mineral law. The term includes oil, gas, coal, uranium, geothermal resources, and so on.

Mitigation: An action to correct or lessen the severity of an adverse effect.

Monitoring: In regard to disturbances caused by mining, the site must be carefully observed following reclamation operations to insure that reclamation goals are being met. This monitoring usually involves observations over time.

Nonpoint source pollution: Pollution whose source is general rather than specific in location.

Notice of intention to operate: Filed by an operator who is unsure if the proposed operations might disturb surface resources, this notice briefly describes what the operator intends to do, where and when it is to be done, routes and methods of access to the site, and who owns and operates the property. The Forest Service will analyze the proposal within 15 days and notify the operator whether or not an operating plan is necessary.

Operating plan: Submitted by the operator, the operating plan outlines the steps the company will take to develop and rehabilitate the site. The operating plan is submitted prior to startup of the operations.

Opportunity: As used in this guide, an opportunity is a favorable condition in which to develop or make use of a resource.

Overburden: Barren rock and soil overlying a mineral deposit.

Patent: The official document that conveys to the claimant exclusive fee title to the mineral, and in most cases the surface and all resources.

Placer deposits: A surficial mineral deposit formed by mechanical concentration of mineral particles from weathered debris. The valuable mineral is usually gold, tin, or some other heavy precious metal. The deposit is usually formed by alluvial, marine, or other processes.

Placer mining: The extraction and concentration of heavy metals from placers by various methods using running water and differential specific gravity characteristics.

Postmining: The period following mineral extraction and initial reclamation work during which time the operator is required to monitor the success of the reclamation program and retreat problem areas.

Preliminary investigation: The search for reservoirs of leasable minerals, or the preliminary assessment of values of reservoirs already known to exist in order to identify the approximate extent of payable ground.

Production: The process of extracting and transporting mineral products from the site to a processing location or to market.

Program: As used in this guide, a program is a Forest Service administrative framework in which policy and decision-making, budgeting, on-the-ground activities, and reporting functions are accomplished.

Prospecting: A general term for a group of activities that range from regional appraisals to detailed reconnaissance; the search for new prospective deposits or reservoirs, or the preliminary assessment of the values of deposits or reservoirs already known to exist.

Public domain lands: Lands subject to appropriation as a mining claim, subject to sale, or other disposition under the general laws.

Public issue: A subject or question of widespread interest relating to management of National Forest System lands and identified through public participation.

Raptors: Carnivorous birds that have talons or claws for seizing prey.

Reclamation: Returning disturbed land to a form and productivity that will be ecologically balanced and in conformity with a predetermined land-management plan.

Rehabilitation: See reclamation.

Riparian: A broad term referring to land bordering streams, rivers, lakes, and tidewaters.

Salables: Minerals that may be acquired by purchase or free-use permit only; also called common variety minerals.

Sediment: Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

Spoils: The overburden (soil and raw geologic materials) removed in gaining access to the desired mineral deposit.

Stipulations: Amendments made by the Forest Service to an operating plan for leasable minerals.

Succession: The process whereby one association of species replaces another, or the progression of vegetation over time on an area.

Surface mining: A broad term that refers to any process of removing earth, rock, and other material in order to extract the underlying mineral deposit.

Tailing pond: Area in which the waste material remaining after raw minerals or ore have been processed is contained. This term often refers to waste areas from hardrock mining, while the term "spoils" refers to wastes from open-pit mining.

Uncommon variety minerals: Minerals of the similar type as common variety or salable minerals, but with unique properties giving them distinct and special value. If classified as uncommon variety, the mineral is disposed of as a locatable.

Underground mining: Mining that involves extracting ore without removing the material that lies above it, called overburden.

Ungulates: Hoofed animals.

Wildlife: For purposes of this guide, wildlife consists of terrestrial and aquatic animal species.

APPENDIX B

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APPENDIX C

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* GOVERNMENT PRINTING OFFICE: 1987 - 573039 / 61046

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Summarizes and discusses concerns for the biologist working in minerals-area management. Topics include the biologist's role in minerals-area management; the legal framework; land-management planning; the phases of mining; guidelines for evaluating the impacts of mining on wildlife; mitigation measures; and opportunities for wildlife management.

KEYWORDS: Wildlife, mining, minerals-area management, reclamation, mitigation.

THE SEAM PROGRAM

The Surface Environment and Mining Program, known as SEAM, was established by the Forest Service to research, develop, and apply new technology to help maintain a quality environment while helping meet the Nation's mineral requirements. SEAM is a partnership of researchers, land managers, mining industries, universities, and political jurisdictions at all levels.

Although the SEAM Program was assigned to the Intermountain Station, some of its research projects were administered by the Rocky Mountain and Pacific Southwest Research Stations.

MINERAL USER GUIDES

Other User Guides for specialists involved in minerals activities are:

- User Guide to Vegetation, Gen. Tech. Rep., INT-64
- User Guide to Soils, Gen. Tech. Rep., INT-68
- User Guide to Engineering, Gen. Tech. Rep., INT-70
- User Guide to Sociology and Economics, Gen. Tech. Rep., INT-73
- User Guide to Hydrology, Gen. Tech. Rep., INT-74

To obtain copies of these guides, write: Intermountain Forest and Range Experiment Station, USDA Forest Service, 507 25th St., Ogden, UT 84401.